MODERN PLASTICS

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FEBRUARY 1945

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MODERN PLASTICS

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All editorial contents bearing on military subjects have been released for publication by the Armed Services.

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Member Audit Bureau of Circulations

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VOLUME 22 FEBRUARY 1945 NUMBER 6

General Section

Plastics—Engineering Section

Technical Section

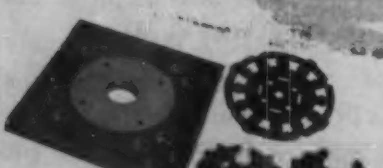
News and Features

A fungus likes its "supper" warm and wet!

—but it won't get fat on INSUROK T-640!

Here is a modern precision plastic that's tailor-made for the humid, spore-laden atmosphere of the tropics. Under conditions where hungry, fast-growing fungi and mildew eat their way into equipment, destroying it in a matter of hours—INSUROK T-640 is proving its ability to outlast and out-perform ordinary materials . . . *with or without protective finishes.*

The reason is simply that, so far as we know, there is no laminated phenolic plastic which has the *low moisture absorption* of Laminated INSUROK, Grade T-640. In addition, it has uniform dielectric and mechanical characteristics, and can be fabricated. These and other features make INSUROK T-640 ideal for use with radar, communications receivers and transmitters, and a variety of other war or peacetime products. Write for complete information about INSUROK T-640. Or ask Richardson Plasticians to suggest a grade or type Laminated or Molded INSUROK best suited to your needs.



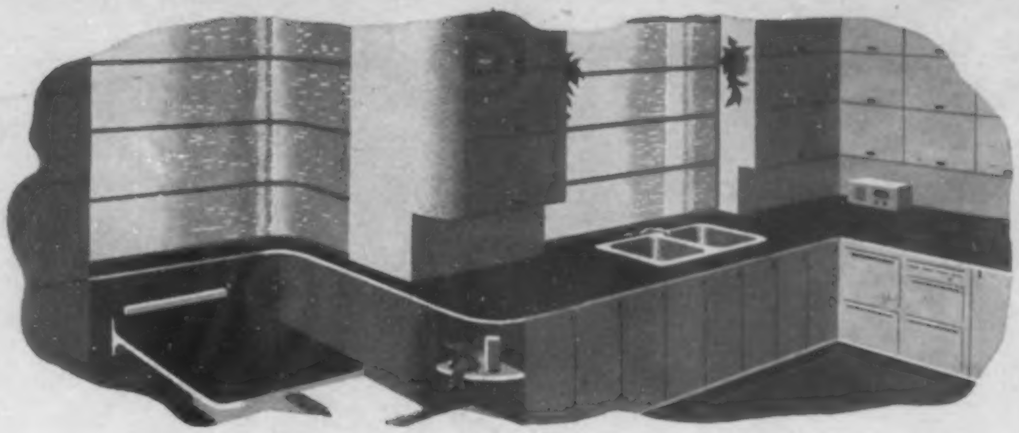
Parts made of Laminated INSUROK T-640, typical of those used where low moisture absorption is essential.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
DETROIT OFFICE: 6-252 G. M. BUILDING, DETROIT 2, MICHIGAN NEW YORK OFFICE: 75 WEST STREET, NEW YORK 6, N. Y.
CLEVELAND OFFICE: 326-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

Whether you build Minesweepers or Kitchen Equipment . . .



..........*your* product can be improved with a Kimpreg* Surface

A revolutionary new alloy-like material is achieved by fusing to plywood's surface a cured plastic skin of KIMPREG. This resultant material is not a plywood in the ordinary sense, not a conventional plastic laminate. It is a brand new, better structural medium with countless applications in many products—including, very probably, those *you* plan for post-war production.

With KIMPREG, plywood is converted into an improved substance which can be machined, formed and fastened like ordinary wood—yet has a plastic's smooth, tough surface and beautiful, permanent, paintless finish.

KIMPREG adds the following advantages to plywood: 1, increases durability and flexural strength; 2, provides resistance to moisture and vapor; 3, armor-plates against extreme abrasion; 4, prevents surface checks; 5, diminishes grain-raising effects; 6, makes the material scuffproof, splinterproof, snag-resistant; 7, affords a stainproof, washable, "wipe clean" surface; 8, creates resistance to chemical action, decay, temperature-extremes, fire, vermin, and mold. Moreover, it is warm to the touch, does not have the chill "feel" of metal surfaces.

Today all KIMPREG is required for military needs, ranging from airborne "prefab" huts to glass-smooth tables for packing parachutes without snagging. Hence, the wartime color of KIMPREG is a soldierly olive-drab. Post-war, however, it will be offered in a variety of appealing hues.

Now is the time to investigate the possibilities of KIMPREG-surfaced materials for your *peacetime* requirements.

Kimpreg TRADE MARK

A PRODUCT OF Kimberly Clark RESEARCH

**Kimpreg (trade-mark) means Kimberly-Clark Plastic Surfacing*

Among the users of KIMPREG are: Buffelen Lumber & Manufacturing Company; Olympic Plywood Company; Washington Veneer Company; and The Wheeler, Osgood Company; all of whom are currently producing a Douglas Fir Plywood surfaced with KIMPREG. This product is sold under the trade name of Inderon.

Send Coupon for FREE KIMPREG Book to:
Kimberly-Clark Corporation, Neenah, Wis.

MP-245

Name____________________

Firm____________________

Type of Business____________________

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Covering the color span in BLACKS
Various degrees of jetness are obtainable through use of the Columbian color blacks. These five standard pigments represent the complete black spectrum from black through blacker to blackest, and each one produces by itself the color qualities desired. Their color is permanent.
Among the pleasing features of the Columbian color blacks is their compatability. They are chemically stable, non-reactive and exceptionally uniform in color and particle size. They are non-bleeding and non-toxic. All of them now are being used extensively in plastics.
BEADED BLACKS...
FOR CLEANLINESS
NOW ARE AVAILABLE
We invite technical inquiry and will gladly send samples.
COLUMBIAN COLLOIDS
400 TONS OF SMOKE A DAY
COLUMBIAN CARBON COMPANY
COLUMBIAN CARBON CO. • BINNEY & SMITH CO.
MANUFACTURER
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What is "PINKO"?

From the laboratories of Hummel-Ross come "Pinko" and "Pink-O-Perf," papers which are proving ideally suited to plastic impregnation and plastic laminates.

"Pinko," available in 5 degrees of absorbency and in calipers from .006 to .050, has characteristics that make it outstanding for plastic lamination.

Where unusual penetration is required, or where every effort must be made to prevent delamination, "Pink-O-Perf" is the answer. This perforated sheet can be furnished in calipers from .006 to .020 and in the same five degrees of absorbency.

Samples are yours for the asking . .

originators • creators

HUMMEL-ROSS FIBRE CORPORATION

HOPEWELL, VA., U. S. A.

HOPEWELL KRAFT PINKO

PINKO-PERF

Engineering Service

For Engineers *and* Purchasing Agents

BY THE PIONEER CUSTOM INJECTION MOLDER OF AMERICA

THE high quality of Erie Resistor Plastic Products reflects the knowledge and experience of Erie Resistor engineers.

The benefit of this knowledge and experience is offered you through our "engineering service" to help you to arrive at the correct design for your plastic parts.

Our service to you is based upon:

1. A thorough and up-to-date knowledge of molding materials, their characteristics, advantages and limitations for specific applications.

2. Our years of experience in proper die design and the constant development of new molding techniques, resulting in higher production speeds (faster molding cycles), at the same time retaining the characteristics of high quality such as close tolerance, controlled shrinkage, no flow marks and unusual color depth.

3. The development and utilization of modern facilities and equipment for mechanical and finishing operations such as drilling, tapping, machining, cementing, painting, buffing, and assembling.

Write our Engineering Department concerning any problem involving Injection or Extrusion Molding, or Injection Molded Thermosetting Plastic articles, in sizes ranging from ½ ounce to 18 ounces inclusive. Our new illustrated bulletin describes our facilities and background in detail. A letter to us will bring a copy to you.

Plastics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

Let's All Back The Attack—Buy EXTRA War Bonds


HANDLED WITH CARE
Handled with care . . . by Consolidated! Although the twin ends of this oven door handle were not difficult to mold—they did require extreme CARE in every stage! • As a fitting companion to a quality oven, the plastic material had to match the snowy white of the stove's porcelain finish. As a fastening facility, the threaded brass inserts had to be compression molded in place . . . accurately! Held also to close tolerance, the shanks, when inserted into the arched chrome-plated tube, formed a friction-fitted, rigid attachment assembly. • The time may soon come when plastics accessories of all types will again swarm back into service . . . and in order to be sure that yours be HANDLED WITH CARE, we would like to tell you more about "Consolidated's Way" of assuring satisfaction. Inquiries invited!
Consolidated MOLDED PRODUCTS Corporation
309 CHERRY STREET, SCRANTON 2, PA.
BRANCHES: NEW YORK • BRIDGEPORT
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*WAYNE, NEW JERSEY
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FACILITIES* COMPLETE AND AMPLE
.. to fulfill TODAY'S big tasks!
Peacetime production of the world's myriad of commodities, necessities and luxuries in its entirety is far greater in scope than is generally realized. Supplying the needs of a nation is a major undertaking; when the potentials are a host of nations, the task stuns the imagination.
As with industry in general, the experience and craftsmanship of MACK MOLDING has advanced to a position comparable with other allied fields of endeavor. This fact, plus the adequate facilities of three modernly equipped and completely staffed plants, give credence to our offer of customer collaboration.
Inquiries should be addressed to MACK MOLDING COMPANY, 100 Main Street, Wayne, New Jersey.
Mack
MOLDED EXCELLENCE
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Plexiglas ... for practical machined plastic parts

Handy PLEXIGLAS hose couplings made by J. H. Whittemore Company consist of a ball and socket, accurately fitted and locked together by a lip and flange device, to permit joining of lengths of garden hose. Even at 80 pounds water pressure, the fittings remain water tight.

With a twist of the wrist, nozzles and couplings of PLEXIGLAS can be readily joined and "broken." To attach the fittings, the end of the hose is slipped over a knob in the coupling sleeve and locked against it by backing up a large hexagonal PLEXIGLAS nut.

For parts such as the hose fittings shown above, PLEXIGLAS can be machined as easily as copper or brass . . . drilled, tapped, threaded . . . cemented or heat-welded into strong joints . . . cut on ordinary wood saws . . . formed to almost any shape simply by heating to 220°—300°F.

For post-war mass production — even of parts as complicated as those above — PLEXIGLAS can be injection molded complete with threads and flanges.

Ease of fabrication and molding is only one of the important reasons why PLEXIGLAS is used in so many varied applications. High tensile strength, resistance to moisture and chemicals combine with light weight and weatherproof crystal clarity to make it practical as well as highly decorative.

Keep PLEXIGLAS in mind when planning *your* new products. For complete information on its *proved* advantages, just call the nearest Rohm & Haas office—Philadelphia, Los Angeles, Detroit, Chicago, Cleveland, New York. Canadian Distributors: Hobbs Glass, Ltd., Montreal.

Only Rohm and Haas makes

PLEXIGLAS

CRYSTAL-CLEAR ACRYLIC SHEETS AND MOLDING POWDERS*

*Formerly CRYSTALITE Molding Powders

PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets and molding powders manufactured by Rohm & Haas Company.
Represented by Cia. Rohm y Haas, S.R.L., Carlos Pellegrini 331, Buenos Aires, Argentina, and agents in principal South American cities.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics . . Synthetic Insecticides . . Fungicides . . Enzymes . . Chemicals for the Leather, Textile and other Industries

The plastics pot keeps boiling

ALL THE WORLD'S A-STEW over the part that plastics will play in the post-war production of gadgets, widgets and the more important articles of commerce. Owens-Illinois, though chiefly engaged now in making fine plastic closures for containers, does its bit to keep the plastics pot boiling. If you need closures, write us. If plastics are part of your post-war picture, keep in touch with us.

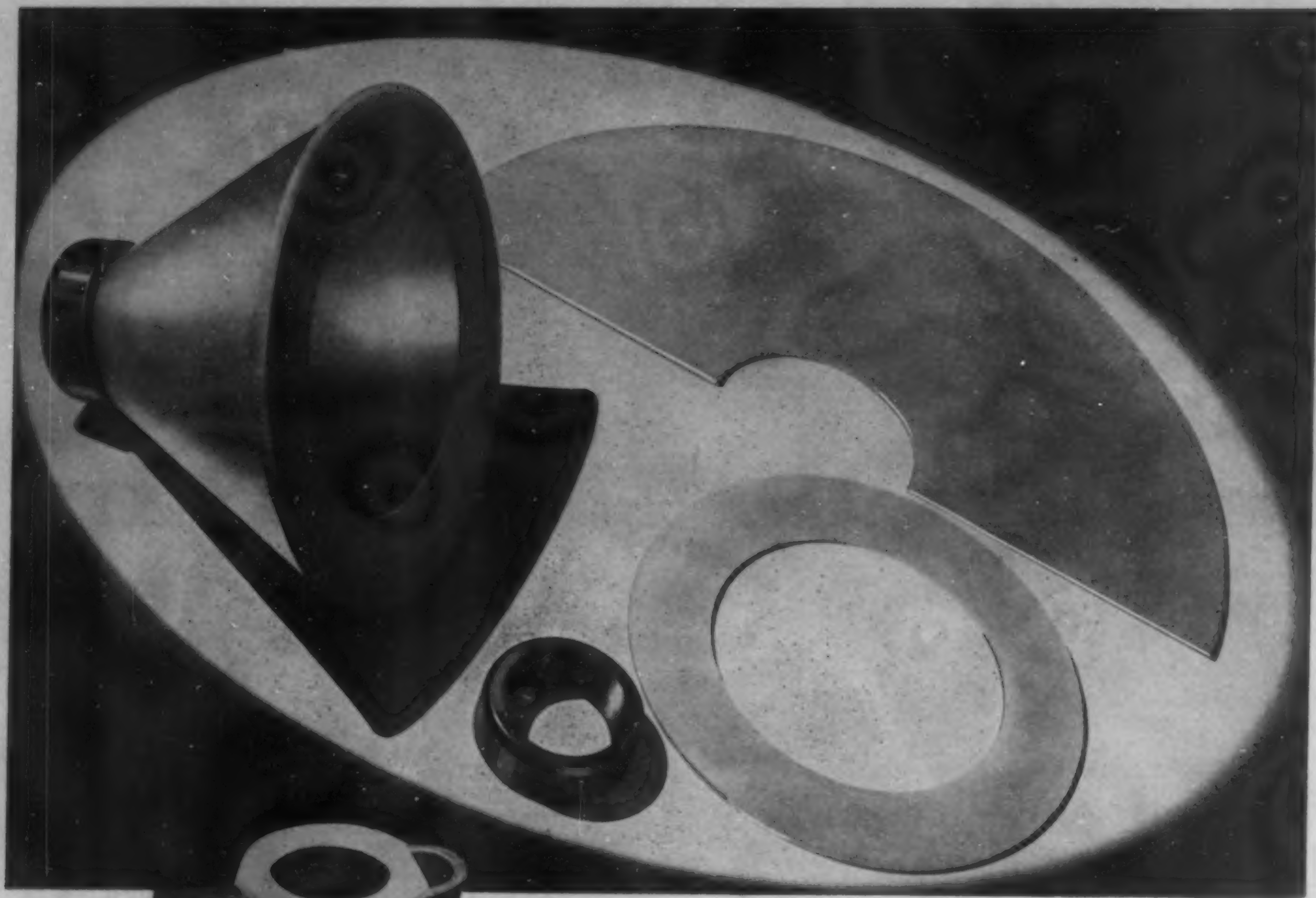
Enjoy a "Lift to Living" that is a "Lift to Selling" for products packed in new Duraglas Containers—Fred Waring and his Pennsylvanians for a full half-hour every week, coast-to-coast over the Blue Network every Thursday evening 10 P.M., EWT . . . 9 P.M., CWT . . . 8 P.M., MWT . . . 7 P.M., PWT.

CLOSURES AND PLASTICS DIVISION

OWENS-ILLINOIS GLASS COMPANY

TOLEDO 1, OHIO

Branches in All Principal Cities



SARAN IS EASILY FABRICATED FROM STOCK MATERIAL . . . .

A little ingenuity and some stock Saran go a long way in developing new, useful products, particularly when you need something to resist the action of corrosive materials . . . Shown here are only a few of the things we have developed in our own laboratories to meet industrial needs. On the top is an anti-splash acid funnel made from a sheet of Saran and half of a pipe coupling. At left is an anti-splash acid pitcher and an acid condenser. All were cut from stock material and welded by simple methods, with tools easily available. It will pay you to investigate the versatility and ease of handling of Saran.

***Send** for our latest P-11 Technical Bulletin, just off the press, which illustrates methods of welding Saran. Let us put you on the list to receive our coming new P-12 Bulletin covering the fabrication of Saran.*

***SARAN**

HODGMAN RUBBER COMPANY HR

*U. S. Pat. No. 2160931

HODGMAN RUBBER CO.

FRAMINGHAM, MASSACHUSETTS

New York 16	Chicago 2	San Francisco 5
261 Fifth Avenue	173 West Madison Ave.	121 Second Street

Saran tube, pipe, fittings, sheet, rod and extruded products of rubber and plastic—Horco-X coated fabrics

PLASTIC LINERS for *Combat Helmets*

Light plastic liners for the new shrapnel-proof helmets . . . a radical departure from and improvement on the helmets of World War No. 1!

Yes, plastics are playing an important part in this war. For many articles they are inherently superior to metal. They are pinch-hitting on many a job where metals are just not available. And as with metals, surfaces and edges often need cutting down, polishing and buffing to make them smooth and to promote precision in manufacture.

In the field of plastics, as of metals, Lea Technicians are lending a helping hand on such problems. They are thoroughly skilled in the art of preparing and finishing surfaces, and they have the compounds with which to work. The Lea Method plus Lea Compound or Learok, or a combination of both, is now standard practice in hundreds of plants.

THE LEA MANUFACTURING CO.

WATERBURY 86, CONN.

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods and Compositions

NO. 2 ROYLE PLASTICS INSULATING MACHINE

"ANY INSULATION" WON'T DO WHEN YOU'RE FIGHTING A GLOBAL WAR . . .

The long felt need for insulating materials possessing properties not found in rubber sky-rocketed as the war spread to all quarters of the globe. This was a need that had to be filled almost overnight. Delays meant the needless loss of precious lives—stymied campaigns—prolonging the war.

The ingenuity and experience of the chemical industry and wire processors had developed suitable materials for plastics insulation. John Royle & Sons—progressive pioneers since 1880 in the manufacture of extrusion machinery—were called upon to produce the necessary equipment for processing plastics insulation.

Today Royle Continuous Resin Insulating Machines are delivering plastics insulated wire in many of the nation's wire processing plants—"enough and on time."

More general applications of the Royle Continuous Resin Insulating Machine are manifesting themselves. The horizon is bright, but that must wait until the war has been won.

ROYLE
PATERSON
N. J.

PIONEER BUILDERS OF EXTRUSION MACHINES SINCE 1880

PATERSON 3, NEW JERSEY

AKRON, OHIO
J. C. CLINEFELTER
University 3726

LONDON, ENGLAND
JAMES DAY (MACHINERY) LTD.


DEEP COMPRESSION MOLDING
with MEGATHERM* Electronic Heat

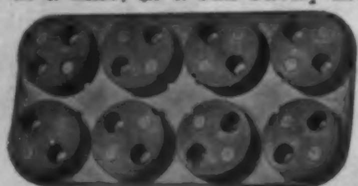
IT PAYS

Mold Automatically

CASE HISTORIES PROVE IT

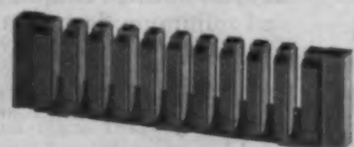
• 88¢ per M.

These insulators are $\frac{7}{8}$" dia., $\frac{3}{16}$" thick. They are made eight at a time, in a sub-cavity mold. Flash is very thin, removed by simple tumbling. Better than 6000 are molded per day (24 hours) one machine, and four or five Automatics are kept running continuously on the job. The cost quoted is for material, heat and power and labor only, does not include overhead or amortization. With sub-cavity molds Automatic production of small parts is high, up to 10 M. or more per day . . . Automatic accuracy is obtainable on long runs.

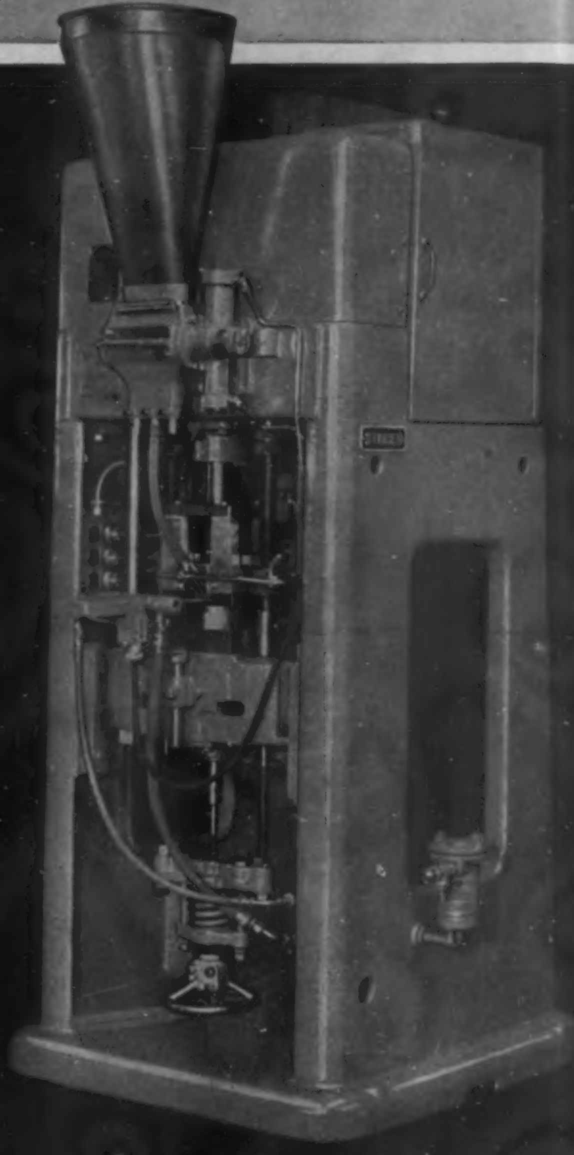


• IMPOSSIBLE?

A number of molders said this job was impossible . . . turned it down. It is a harmonica comb in which reed slot tolerances must be held to .0005" to make them airtight when the reeds are in place. This molding is an excellent example of intricate work profitably handled Automatically . . . parts are identical, uniform, accurate . . . rejects are negligible.



F. J. STOKES MACHINE CO.
5934 Tabor Road Philadelphia 20, Pa.



The Stokes 200-D Completely Automatic Molding Press. 15 tons capacity.

Patented in U.S. and abroad. Other patents pending.

Why not investigate the demonstrated advantages and economies of Completely Automatic Molding? We are prepared to make molding and installation cost studies for you.

F. J. Stokes MOLDING EQUIPMENT

FJS Est. 1895

FOR JOBS LIKE THIS

Letters and figures on this plastic dial (for electric refrigerator temperature control) were included in the mold. This resulted in a substantial saving over the cost of machining them into the piece, after molding.

Such a method might seem to be simple and obvious, but it required much special skill. The correct plastic compound with the proper shrinkage had to be chosen. Then, the molds had to be designed so that the pieces could be removed without defacing the markings.

This special "know-how" is what we at General Industries offer you in our molded plastics division. Of course, we have all the machinery needed for large or small jobs in compression, transfer or injection molding. But in addition, we have that ingenuity, skill in mold making and willingness and ability to think through on a job before it is undertaken. In plastics molding, there is no substitute for experience.

If your postwar products call for plastic parts, we suggest you consult us before making definite commitments. While our engineers and facilities are now taxed to the limit with war work, we can discuss your requirements in general terms, and later get down to facts and figures. We'd like to work with you.

ARMY E NAVY

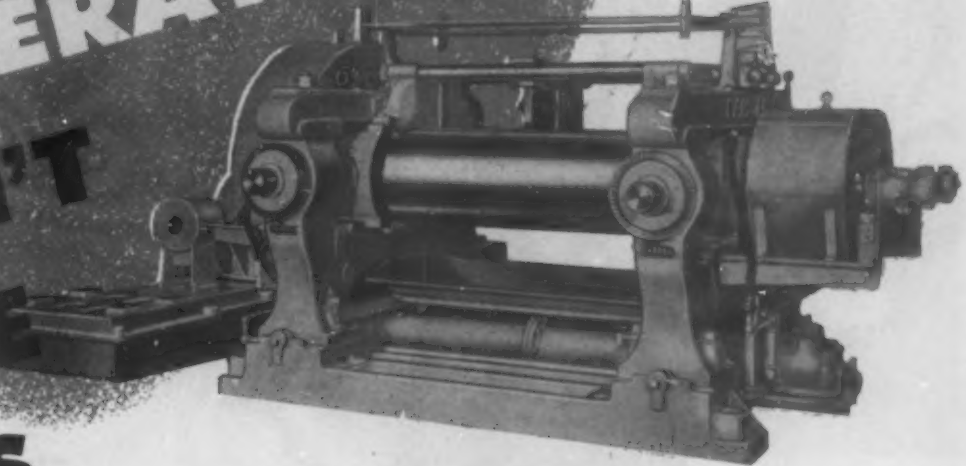
THE GENERAL INDUSTRIES COMPANY

MOLDED PLASTICS

Molded Plastics Division • Elyria, Ohio

Chicago: Phone Central 8431
Detroit: Phone Madison 2146
Milwaukee: Phone Daly 6810
Philadelphia: Phone Camden 2215

HIGH TEMPERATURES WON'T FAZE THIS MILL



IT has been *designed* to process plastics that require high temperatures for converting and mixing.

The rolls are chamber bored, and fitted with a special type of stuffing box to provide proper temperature control. The water-cooled journal boxes carrying the rolls are lubricated by a continuous circulating system which includes a cooler and strainer.

To provide maximum strength, Meehanite, a processed iron having superior physical properties, is used for the housings, bedplate and bull gear. A patented shear pin safety device, fitted between the adjusting screws and front roll boxes, prevents breakage of housings and other parts in case of overloading.

When the mill is to be used for stocks which are sensitive to contamination, the rolls can be chrome-plated and the adjustable guides and mill pan made of non-corroding metals. A special ratchet adjustment for raising the guides permits thorough cleaning of the rolls as well as the guides themselves.

These "designed-for-the-job" mills are available in a complete range of sizes, from 8″ x 16″ for the laboratory up to 28″ x 84″ heavy duty machines for factory production. Write for complete information.

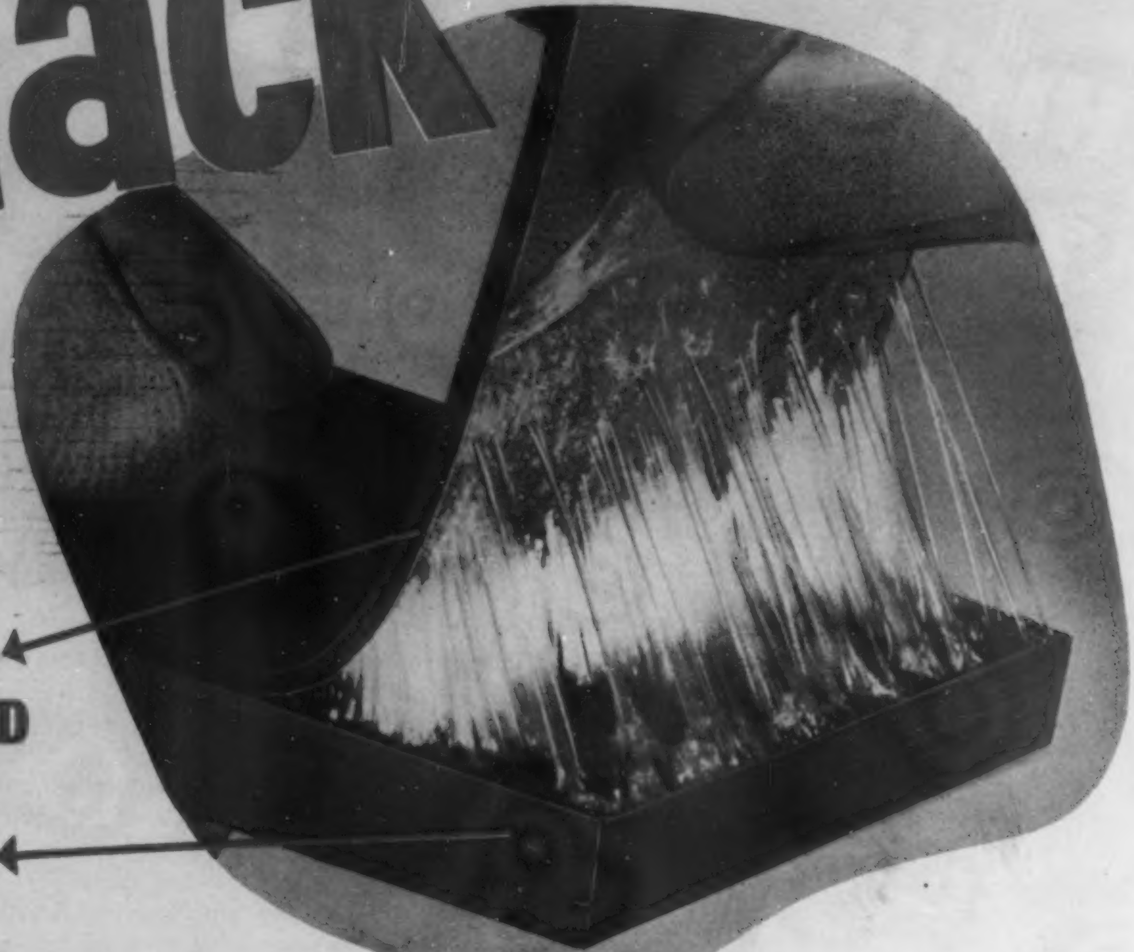
F-B PLASTICS MACHINERY

- Banbury Internal Mixers
- Roll Mills
- Converting, Mixing and Sheeting Rolls
- Calenders
- Extruding Machines
- Hydraulic Presses
- Hydraulic Accumulators
- Sheet Cutters or Planers

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles

Farrel-Birmingham

Tack



...with the new

Pressure Sensitive CORDO-BOND Adhesives

IN contrast to the standard CORDO-BOND Adhesives which provide permanent, high strength bonds . . . CORDO-BOND Adhesives of this new, pressure sensitive type provide a *permanently tacky bond.*

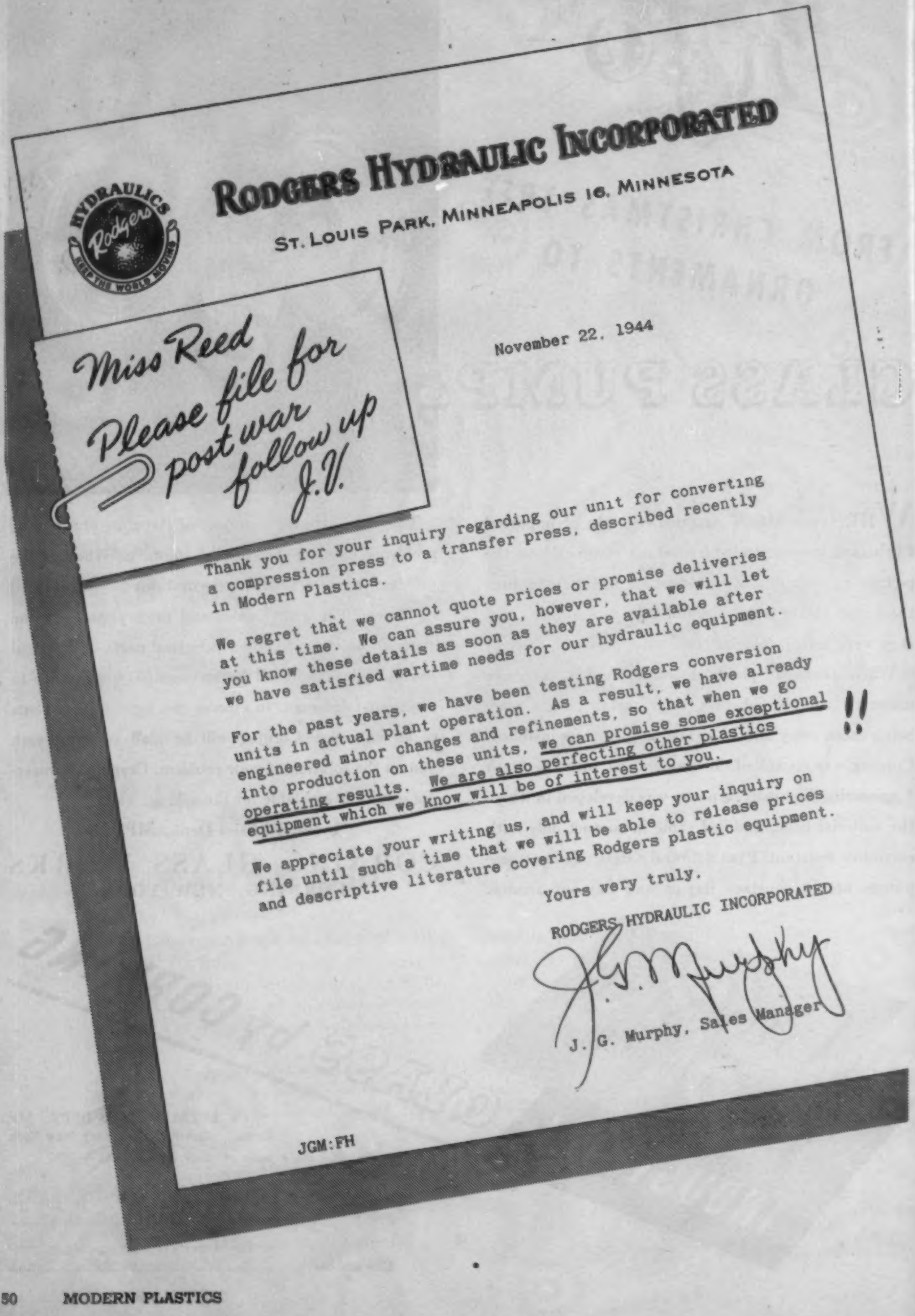
These new, pressure sensitive adhesives will seal *plastics* to *plastics* with a highly tenacious bond. They exhibit strong "legs," instant grab and powerful cling. Many other dry materials such as wood, metal, glass, paper and leather may be sealed in the same manner.

CORDO-BOND Adhesives can solve some of your bonding problems . . . war and post-war. Write, giving full details for laboratory analysis and recommended applications.

CORDO CHEMICAL CORPORATION
34 Smith St., Norwalk, Conn.

INDUSTRIAL COATINGS • FINISHES
INDUSTRIAL ADHESIVES

CORDO-BOND



RODGERS HYDRAULIC INCORPORATED

ST. LOUIS PARK, MINNEAPOLIS 16, MINNESOTA

HYDRAULICS Rodgers KEEP THE WORLD MOVING

Miss Reed
Please file for
post war
follow up
J.V.

November 22, 1944

Thank you for your inquiry regarding our unit for converting a compression press to a transfer press, described recently in Modern Plastics.

We regret that we cannot quote prices or promise deliveries at this time. We can assure you, however, that we will let you know these details as soon as they are available after we have satisfied wartime needs for our hydraulic equipment.

For the past years, we have been testing Rodgers conversion units in actual plant operation. As a result, we have already engineered minor changes and refinements, so that when we go into production on these units, we can promise some exceptional operating results. We are also perfecting other plastics equipment which we know will be of interest to you. !!

We appreciate your writing us, and will keep your inquiry on file until such a time that we will be able to release prices and descriptive literature covering Rodgers plastic equipment.

Yours very truly.

RODGERS HYDRAULIC INCORPORATED

J. G. Murphy

J. G. Murphy, Sales Manager

JGM:FH

Illustrated about 3 times larger than actual size

Santay's Precision Craftsmanship Scores Again!.. The maximum wall thickness of this little coil form is only .008 inch! Just imagine! Only twice as thick as the paper this ad is printed on!

Santay's Precision Craftsmanship has scored again in producing this delicate coil form for the Zenith Radio Corporation. It is used in making their Hearing Aid. The ability to build molds is one of the most important factors in producing such intricate thermoplastic parts successfully. Santay engineers design and build all their own molds.

Santay could possibly do something equally fine for you—not right now of course, because all of Santay's facilities are being devoted to the war effort. However, we would like to honor your post-war problem or inquiry now.

INJECTION MOLDING • METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES

SANTAY CORPORATION 351-359 N. CRAWFORD AVE., CHICAGO 24, ILLINOIS

FORMERLY SINKO TOOL & MANUFACTURING CO.

REPRESENTATIVES: POTTER & DUGAN, INC., 29 WILKESON STREET, BUFFALO 2, NEW YORK • PAUL SEILER, 7279 CORTLAND AVENUE, DETROIT 4, MICHIGAN • QUEISSER BROS., 108 E. NINTH STREET, INDIANAPOLIS 2, INDIANA

QUICK DELIVERY ON RCA ELECTRONIC PREHEATERS

New RCA 2000-Watt Unit Reduces Heating Time to 40 Seconds per Pound of Material

FOR greater press output and fewer rejects, electronic preheating of molding materials has proved effective in a wide variety of applications. On the average, press output has been *increased 50% or more* when electronic heat replaced previous methods; *reductions in rejects have run as high as 90%* on difficult molding jobs.

One pound of molding material can be heated to 275°F. in about 40 seconds.

RCA engineers, in developing the new RCA Model 2-B electronic generator, studied the needs of plastics molders. This new unit (shown at right) incorporates many features which make it outstanding in the field, for example:

1. EASE OF OPERATION: The operator merely places the preform (or preforms) on a metal plate (see photo), closes the protective lid (which is perforated so work is always visible to operator), and pushes the ON button. At the end of preset heating period, the automatic timer shuts off the power and opens the lid.

2. AUTOMATIC TUNING: Plastic materials undergo continuous changes in electrical properties as they heat; therefore, to have maximum heating efficiency throughout the heating cycle, the load circuit must be continually retuned. A special electronic compensator built into the RCA Model 2-B does this automatically; thus preheating time is shortened as much as 33% (compared to electronic preheating without continual compensation), and the unit is able to handle proportionately bigger loads.

3. TABLE-TOP HEIGHT: For convenience of operation, the RCA 2000-watt unit is just 42 inches high—ideal for convenience of the operator. No bending over is necessary to load the machine or to adjust it.

4. FLEXIBILITY: To adjust heating rate to job requirements, you merely turn one ordinary control knob.

5. ONE-POSITION OPERATION: Every function necessary to operate this RCA unit can be performed by the operator from one comfortable position. All controls are conveniently located. A standard foot switch can be connected for remote operation.

6. SURFACE TEMPERATURE BOOSTERS: With normal electronic heating methods, preform surface temperatures run slightly lower than inside temperatures due to surface cooling by surrounding air and electrodes. Auxiliary infra-red heat lamps in the RCA 2-B act as compensators and, by keeping electrodes hot, prevent moisture condensation.

AVAILABILITY: Because of the importance of this equipment to the war effort, production of moderate quantities has been permitted. *You can obtain early delivery on rated orders.* RCA engineers will gladly advise you on the suitability of electronic heating for your application. The coupon below will bring you further information; a letter, wire, or phone call stating your problem should be directed to: Radio Corporation of America, Electronic Apparatus Section, Box 70-104, Camden, N. J. In Canada, RCA Victor Company Limited, Montreal.

ELECTRONIC HEAT MAY CUT COSTS FOR YOU! Here's the RCA Model 2-B electronic generator—complete in itself—specially designed for plastics molders. Will preheat approximately one and one-quarter pounds of molding material per minute from room temperature to 275°F. Operates on standard 60-cycle power.

BUY MORE WAR BONDS

RCA ELECTRONIC HEAT

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

SEND THIS FOR MORE DATA

RCA, Electronic Apparatus Section, Box 70-104R, Camden, N. J.

Gentlemen: Please send me "Electronic Heat Speeds Plastics Molding" and "RCA Electronic Generator, Model 2-B." I understand this places me under no obligation.

Name..

Company..

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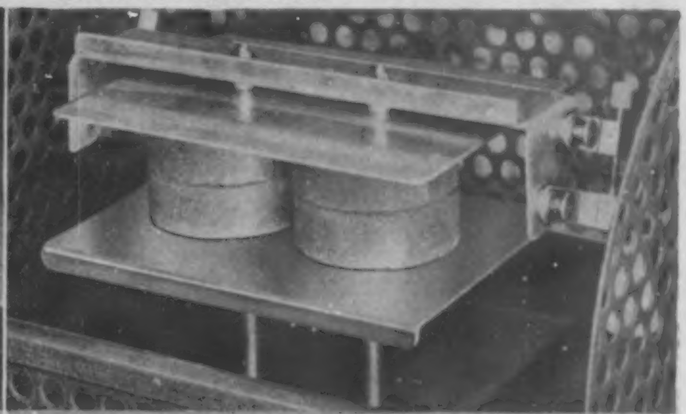
AIRTRONICS Model CB Control Panel. Adjustment of power output and preheating time made in a few seconds with Set-up, Power and Timer Controls. No special training necessary.



AIRTRONICS Model CB Self-Aligning output electrodes. Safety switch turns off power when hood is raised.

Developed expressly for plastics molders—who needed electronic preheating equipment that was more dependable, more versatile and easier to operate—AIRTRONICS units have established enviable *records throughout the plastics industry. Exclusive features of AIRTRONICS design are responsible for* these *higher standards of performance...*

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Unique AIRTRONICS transformer, transmission and coupling elements transmit high-frequency energy from oscillator to load with minimum power loss.

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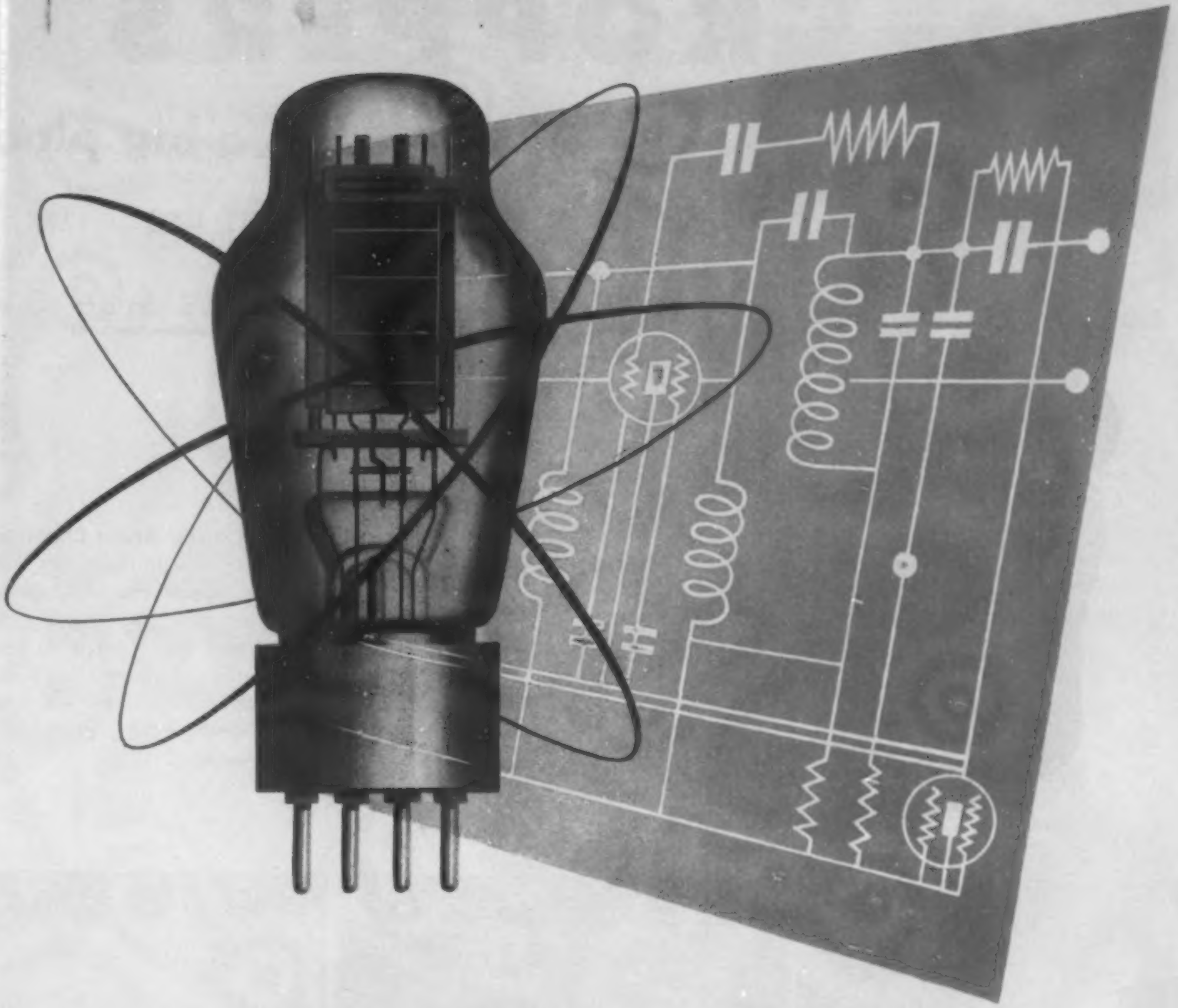

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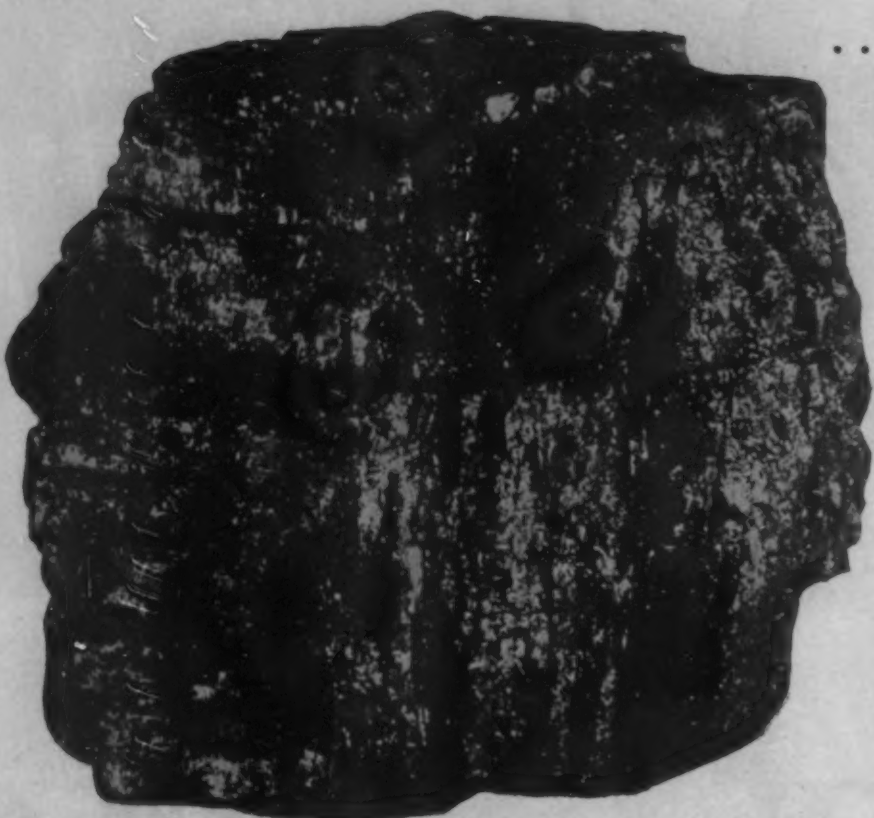

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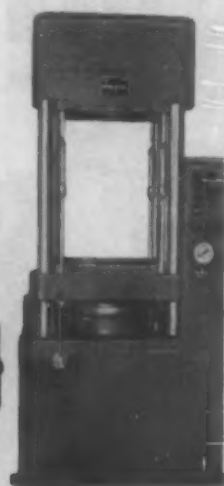

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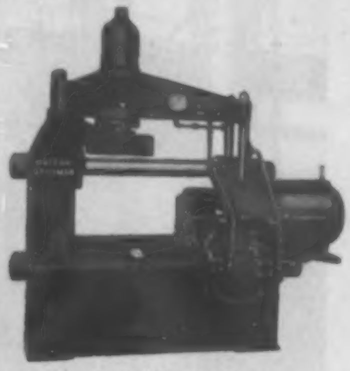

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A Scene From the Metro-Goldwyn-Mayer Picture—EDISON, THE MAN

A comparison of SYNTHANE TECHNICAL PLASTICS with certain metals, debunking a popular notion that plastics being "magic" can be used indiscriminately

IT IS CHARACTERISTICALLY HUMAN to back a winner . . . to ascribe precipitately to vitamins or sulfa drugs or plastics more powers and claims than sober research can keep up with. Plastics have their possibilities . . . and their limitations. Good design is the reward of knowing both.

Plastics are doing many jobs that metals used to do, especially since certain critical metal shortages have cropped up. But, basically, plastics are *not* substitute materials. Correctly applied, they should and do stand solely on their own merits.

INTERESTING COMPARISONS TO PROVE the point can be made between our type of plastics—Synthane—and certain metals. Synthane is made by applying heat and pressure to paper or fabric impregnated with thermosetting resins. It is non-metallic, a fact which should at once suggest uses fundamentally different from those of metals. Actually, Synthane is an excellent electrical insulator, and so you find it in hundreds of radio and electrical products and applications, not in place of metal, but to insulate metal. That does not imply Synthane cannot replace metal. As a matter of fact, Synthane has taken over for metals in pulleys, bearings, panels, structural members, scales, dials. The reasons can usually be traced to one or a combination of the many properties of Synthane technical plastics.

ONE OF THE PRINCIPAL REASONS at present is light weight. Synthane has a specific gravity ranging from 1.20 to 1.70, about half that of aluminum, less than magnesium. So in many unstressed parts for aircraft Synthane is a logical consideration.

SYNTHANE LAMINATED PLASTICS GENERALLY have lower mechanical strength than metals for a given cross section. For example, an approximate comparison might read like this:

	Tensile Strength (p.s.i.) ultimate	Compressive Strength (p.s.i.)
Alloyed Aluminum	16,000–60,000	9,000– 47,000 (y)
Brass	40,000–80,000	28,000–126,000 (u)
Cast Iron	16,000–45,000	80,000–200,000 (u)
Synthane	8,000–12,000	30,000– 50,000 (u)

(y—yield strength
u—ultimate strength)

IT IS IMPORTANT, HOWEVER, TO REMEMBER that on a *weight* basis, Synthane may be stronger though redesign of a part for plastics may be necessary.

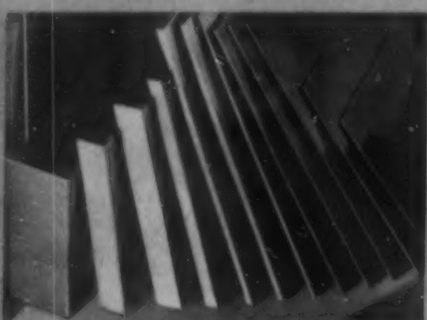
HARDNESS IS A PROPERTY in which another interesting comparison of Synthane with metals can be made. Brinell hardness, tested with 500 Kg. load, 10 mm ball, shows approximately these values: Alloyed aluminum 45–110, Brass 95–150, magnesium (drawn annealed) 29, annealed cast iron 77, Synthane 24–40.

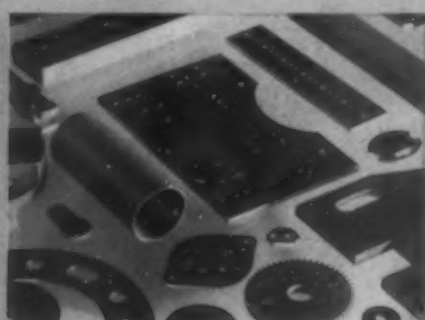
BEHAVIOR UNDER TEMPERATURE CONDITIONS is characteristic of Synthane's non-metallic composition. For instance, whereas the thermal conductivity of aluminum alloys may range from .20 to .54 calories per second per square centimeter per centimeter of thickness per degree C., Synthane's thermal conductivity is about .0005 to .0008. The coefficient of thermal expansion of Synthane is about .0000140 inches per inch per degree F., approximately the same as alloyed aluminum, slightly more than pure aluminum, copper, brass.

CORROSION RESISTANCE IS A SUBJECT of such complications as to temperature, degree of concentration, and type of agent that any comparison with metals would necessarily be lengthy. Synthane does resist corrosion from water, many acids, oils, and salts, and to a greater or lesser extent than metals depending on the metal with which it is compared and the corrosion conditions. Synthane is extensively used as a corrosion resistant material.

APART FROM ITS PHYSICAL, CHEMICAL, electrical and chemical properties, Synthane may be easily and quickly machined by ordinary shop methods, a point which may occasionally influence selection when other factors are the same. And, just as metals are cast for economy in large quantities, so Synthane is available in two molded forms, molded-laminated and molded-macerated, for economy of duplication.

OBVIOUSLY, IN CERTAIN CASES there can be no question of whether to use Synthane plastics or a metal such as when the material must be an electrical conductor or an electrical insulator. In other cases, weight or strength may decide, or corrosion resistance, resilience, hardness, machinability. Or as often happens, the decision may rest upon the extent to which the material required meets many combined specifications. Synthane technical plastics are usually more desired for their combination of properties than for any one specific property for which another specific material or metal may be the only logical answer.





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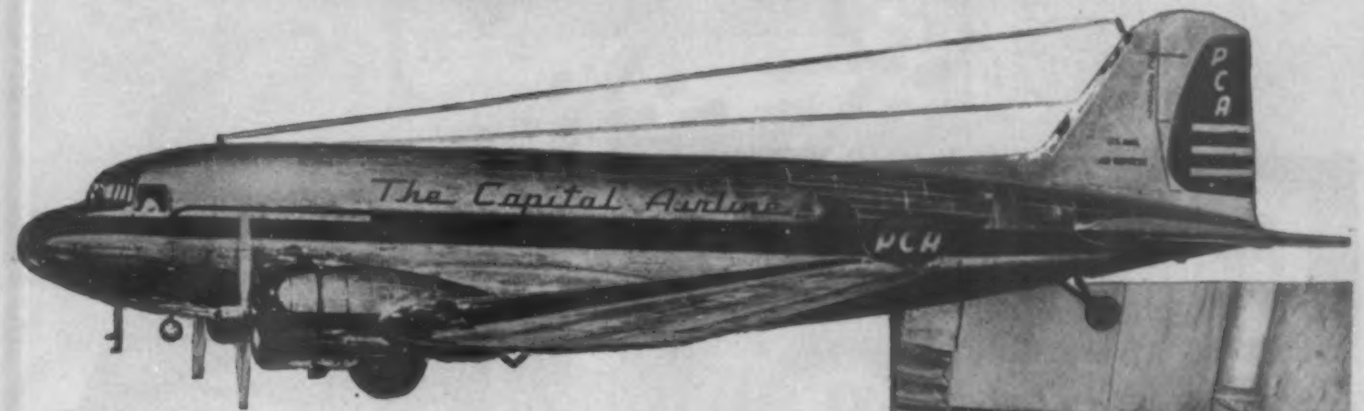


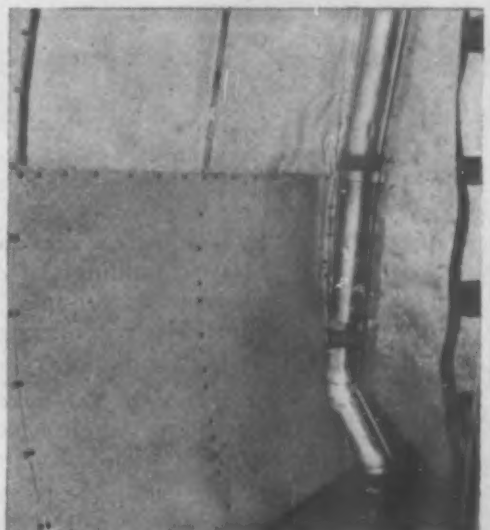
Six-month tests prove its superiority as cargo compartment liner, replacing aluminum

GOOD NEWS for designers and engineers! Some months ago cargo compartment linings made of Continental's new laminated plastic were experimentally installed in progressive Pennsylvania-Central's "Capital Liners." Here's what J. H. Carmichael, P.C.A. Vice President in Charge of Operations, has to say:

> *"The use of Continental laminated plastic as lining for our DC-3 baggage and cargo compartments has been extremely successful—so much so that we have adopted it as standard cargo compartment lining for our entire fleet and have highly recommended it to other airline operators.*
>
> *"Besides saving weight, this laminated plastic has brightened interiors considerably. And it replaces corrugated aluminum, which frequently punctured, leaving jagged edges that would tear bags and packages. After six months' service this new material has not punctured once—nor does it appear that it will in the future."*

This is only one example of the way designers and engineers all over the country are profiting from the experience and facilities of Continental's Plastics Division . . . an alert, progressive organization equipped to give sound, practical advice and assistance at all times!

BEFORE—Heavy corrugated aluminum cargo compartment linings punctured easily, left jagged edges that would tear baggage, reflected little light.



AFTER—Continental laminated plastic cargo bin linings save weight, have not punctured to date, brighten up interiors, making baggage labels easier to read.

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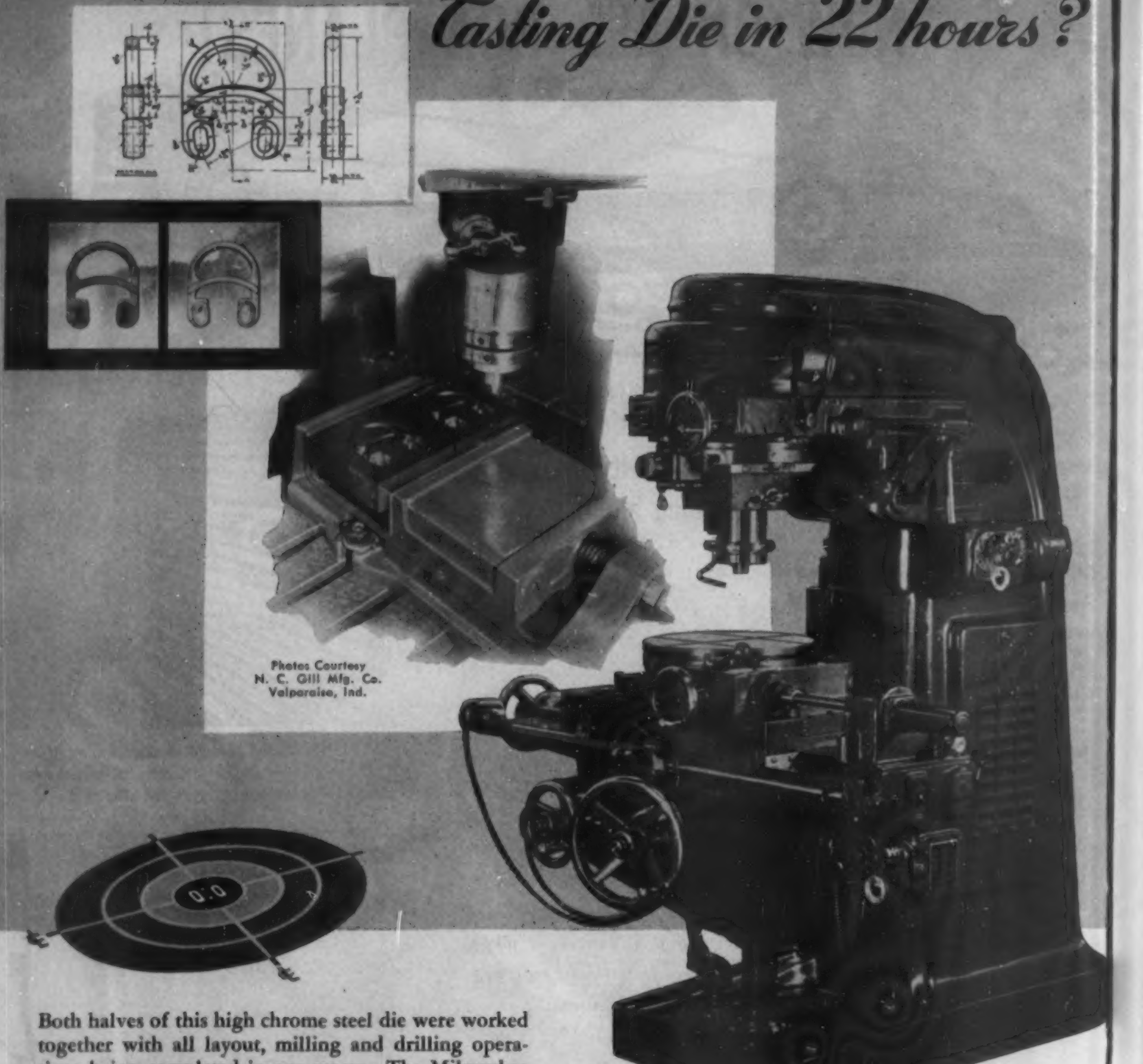

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N. C. Gill Mfg. Co.
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Oven-treated or baked glues, cements and resins stick tenaciously to metal surfaces and thereby present a real problem . . . slowing up production and sometimes stopping it!

However, when precautions are taken to hard chromium-plate the metal parts, these working elements acquire longer service life, won't tarnish under heat and eliminate troublesome sticking. Apparently the reason is that nothing sticks to hard chromium — not even water, oils, molten metals, acids, salts, alkalines.

I.H.C.'s engineers and technicians will be very glad to discuss hard chromium-plating techniques with those who cannot afford to get stuck! Inquiries invited.

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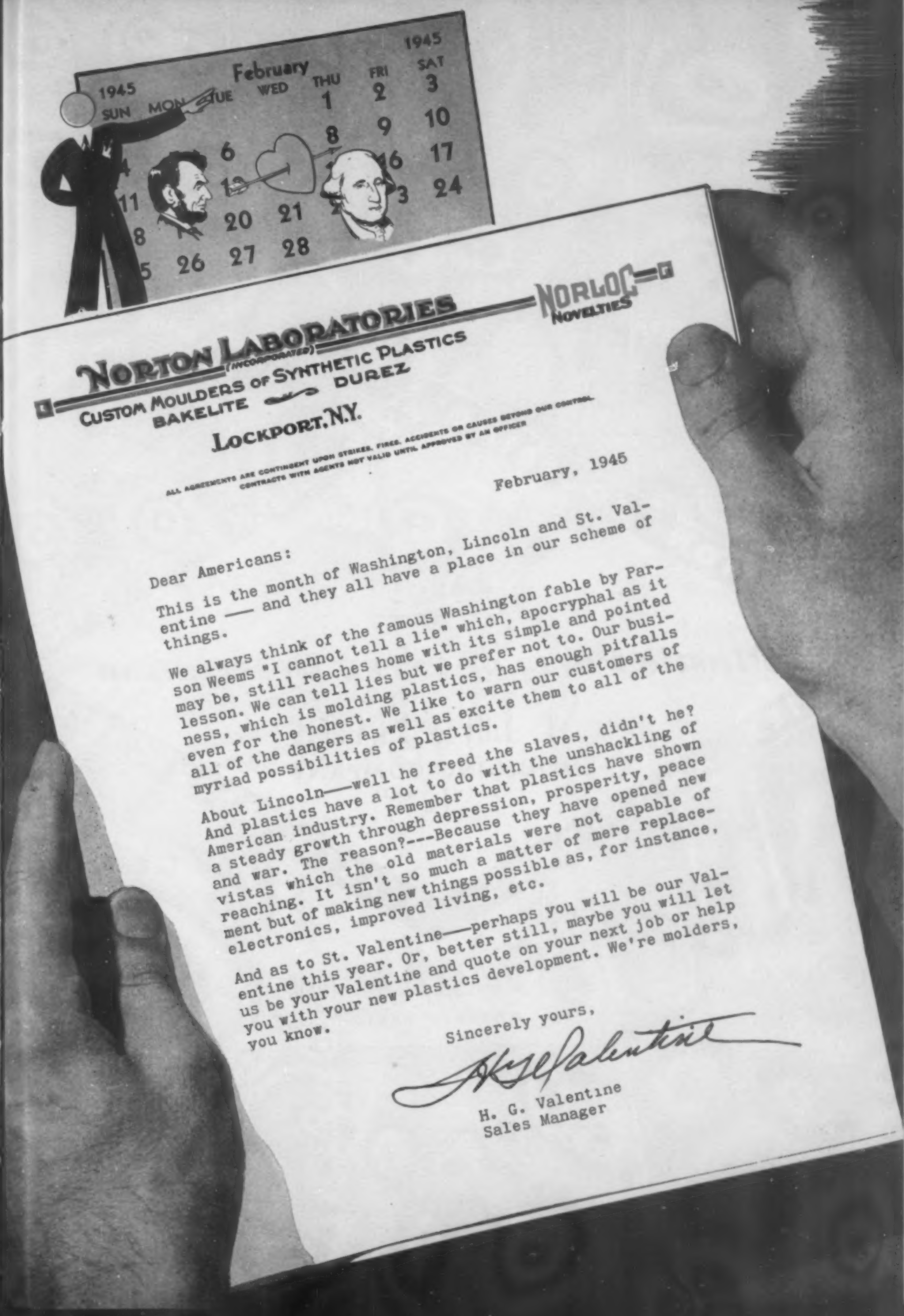

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February, 1945
Dear Americans:
This is the month of Washington, Lincoln and St. Valentine —— and they all have a place in our scheme of things.
We always think of the famous Washington fable by Parson Weems "I cannot tell a lie" which, apocryphal as it may be, still reaches home with its simple and pointed lesson. We can tell lies but we prefer not to. Our business, which is molding plastics, has enough pitfalls even for the honest. We like to warn our customers of all of the dangers as well as excite them to all of the myriad possibilities of plastics.
About Lincoln——well he freed the slaves, didn't he? And plastics have a lot to do with the unshackling of American industry. Remember that plastics have shown a steady growth through depression, prosperity, peace and war. The reason?---Because they have opened new vistas which the old materials were not capable of reaching. It isn't so much a matter of mere replacement but of making new things possible as, for instance, electronics, improved living, etc.
And as to St. Valentine——perhaps you will be our Valentine this year. Or, better still, maybe you will let us be your Valentine and quote on your next job or help you with your new plastics development. We're molders, you know.
Sincerely yours,
H. G. Valentine
H. G. Valentine
Sales Manager


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MODERN PLASTICS

FEBRUARY, 1945 VOLUME 22 NUMBER 6

The case for synthetic textiles—Part II

THIS is Part II of a discussion of synthetic textiles and their place in the structure of the textile industry. Part I, which appeared in the September issue of this magazine, covered the synthetic fibers; Part II covers textile coatings; and Part III, to appear later, will cover textile finishes.

TEXTILE coating is an old art, descending from the Middle Ages, when oil-coated water-resistant wool clothes for seamen were developed by the simple expedient of leaving more of the sheep's grease in the wool yarns than was left in yarns for ordinary uses. The seaman's jacket as developed in the fifteenth century has been preserved for us by the traditional-minded English in the merchant marine uniform, the "peajacket" worn by Mr. Churchill on board destroyers (in recognition of the fact that his Alma Mater, Charterhouse, is, or was in medieval days, the protector of the merchant marine). From medieval times the coating industry has been, as it remains today, an industry of trade secrets; in those days textile weaving and coating was regarded as something between an art and a craft; nowadays, although we have moved it into the realm of exactitude, the different results obtained from the same formulae suggest that it is still a craft touched with art as well as science.

War, with its inevitable stress on the concrete, has tremendously expanded many areas of organized knowledge, perhaps none more than textile coatings. It has enhanced the importance of coated fabrics and enlarged their scope. For the first time in history an army had to be equipped to fight all over the world, and the same Quartermaster Corps had to supply clothing for the Tropics and the Arctic, for the jungle and for the desert. Traditional fibers—cotton and wool—still furnished the bulk of military clothing; but coatings supplied specified properties—gasproofing, waterproofing, mildewproofing—as the battle area dictated.

Even in normal times the equipping of some ten million men with proof clothing would have been an achievement, but in the face of the war supply shortages, it seemed at first an impossibility. Crude rubber, the chief prewar waterproof coating, was immediately put on allocation for other war needs; synthetic rubber, with the exception of neoprene and negligible quantities of the thiokol rubbers, had not yet been developed; some resins once used for coatings had been put on allocation for more critical industries, and new experimental coatings had to be developed. Thus war furnished the impetus and financed the development of a huge experimentation in coated fabrics which private industry could never have financed in the same short time.

In another respect, too, war changed the traditional practice of the industry. War—and the Quartermaster—made the manufacturers of coated fabrics specification-conscious. Before the war, a coating was just a coating, the film varying in composition, weight and adhesion according to the coater who compounded it. Scientific specifications were unheard of, as was the testing laboratory where fabrics are carefully tested for tear strength, adhesion, resistance to humidity, moisture, flexing and abrasion, as well as for tackiness at 200° F. and cold flexibility at −60° F. The coating compound is specified and, as weights are particularly important in this war, the weight of the base fabric, the coating, and of the finished fabric, all are specified in ounces per square yard. Despite these exact requirements it is extraordinary to note the difference in appearance of coated fabrics meeting the same specifications—a triumph, perhaps, of the human element in a machine age, or of trade secrets in an old craft.

We should perhaps distinguish at the start between fabric coating, fabric impregnation, and the treating of fibers by impregnation. While the difference between them may be said to be one of degree, the theory underlying each process is different, and the results are often radically different. Roughly, the distinction between coating and impregnating is that coating deposits a continuous film or layer on top of the woven fabric, anchoring itself to the fibers but not exerting any intrinsic change on the fibers themselves (which, under a thin coat, can still move).

An impregnation coating (usually done by dipping the fabric) deposits the coating on both sides of the fabric, filling the interstices between the yarns but likewise exerting no chemical change on the fibers themselves. Impregnation coating cements the yarns together. Fiber finishes, on the other hand, which are also done by impregnation in a bath, actually change the intrinsic nature of the fibers, though they do not fill the interstices of the fabric nor cement the yarns together. Their effect on the fibers is either by chemical reaction with them or by impregnation of the hollow center of the fiber. Paradoxically, fiber finishes do not usually change the appearance, flexibility or hand of the fabric, whereas coating alters it materially. Finishes deposit only a fraction of the resin deposited by an average coating and are usually done by the dyers.

Each technique has its advantages and disadvantages. The most commonly cited disadvantage of coated fabrics is that they do not allow the fabric to "breathe," i.e., the

KODACHROME AND HALFTONE, COURTESY MONSANTO CHEMICAL CO. 1

1 and 2—Such a present-day tragedy as the spilling of a glass of tomato juice will be but a momentary annoyance when coated table linens, which can be wiped clean with a damp cloth, become generally available

2

continuous layer of film prevents the passage of water vapor and air through the interstices of the fabric, making it hot and uncomfortable to wear. Fiber and fabric finishes, however, do allow fabric to breathe. They do not seal interstices of the fabric although they may seal interstices between the fibers of each yarn. By their very nature then, finishes are not waterproofing processes, but they may be water repellent.

The chemical or physical change which the finish makes on the fibers depends on which of many processes are used. Both surface coating and impregnation coatings lower the tear strength of the fabric, while fiber finishes lower the tear strength very much less, if at all. To the extent to which rigidity of the fabric is increased, tear strength is decreased. Generally speaking, therefore, an impregnation coating lowers the tear strength more than a surface coat, because it binds and makes rigid the individual fibers. Thus a cotton fabric coated on one side has better tear strength and flexibility than the same fabric coated on both sides. These distinctions can be only generally drawn, however, since they are distinctions of degree.

Coating processes

The new coating materials developed by the war were considerably influenced by prevalent coating processes, the most common of which were spread and calender coating, though roll and dip coating were common for the drying oils. Brush, extrusion and spray coating processes are seldom used for textiles, unless one excepts a method[1] of coating yarns which

[1] The Plexon method, Freydberg Bros.-Strauss, Inc.

3 COURTESY COTAN CORP.

3—Coated fabrics have been and will continue to be widely used in the luggage and women's handbag fields. In part, this popularity can be attributed to the range of colors in which these materials are now available

is similar to an extrusion process.

Standard coating practice involves special finishing of the base fabrics. They are picked clean, the misweaves and lint which prevent a smooth coat being removed (for gas-impermeable and waterproof Army clothing this is particularly important); and are desized and dried. Other finishing processes are sometimes necessary, depending on the fabric construction and the end use. Lightweight fabrics, particularly, are an ever-present problem in coating, as they have a tendency to slack sections and to slack or tight selvages that prevent a smooth film. Such stretched spots are cut out, as are breaks in the selvages.

Spread coating is done by three types of machines—the knife spreading, knife blanket and knife roller machines—but in each of them the principle involved is that the fabric passes over a roll and thence under a suspended knife which regulates the thickness of the coating. The coating compound is placed on the fabric just in front of the knife, and is held there by the pull of the fabric moving toward the knife. The tension of the fabric as it passes under the knife and the angle at which the knife is placed largely determine the thickness of the film or coating, though it is also affected by the viscosity of the compound and the speed at which the fabric moves. A sharp-bladed knife is best adapted for depositing a smooth film and a minimum weight of coating, and a round-bladed knife for depositing a maximum weight of film with as few coats as possible.

The most popular spread-coating machine is the knife spreader; in fact, the great volume of all fabric coating is by knife spreader. It depends on multiple coats for film thickness; for ordinary coatings 3 to 15 coats are applied, though many military fabrics are merely skim-coated with 1 or 2 spreader coats (usually having a heavy calender coat on the reverse side). In contrast to the calender, which usually necessitates no solvent, knife spreading involves the use of solvents; but a heavy, viscous, non-impregnating compound is generally used with the knife spreader and there is not a large amount of solvent to be evaporated.

The adoption, some years before the war, of the knife

4 COURTESY FREYDBERG BROS.-STRAUSS, INC.

4—These coated yarns were produced by a process whereby individual yarns are coated with resin. Called "an impregnation and coating," the process is essentially a dip coating. Woven or knitted on standard mill equipment, the yarns are made into textiles for use in such articles as shoes handbags and draperies

spreading process in pyroxylin and artificial leather coatings made that process preeminent. Pyroxylin coatings are plasticized, usually with castor oil (a fact which is also responsible for the poor weathering of pyroxylin, as the coating cracks in cold weather and the oil exudes in hot weather). The coating compound is pigmented and applied to the fabric in several coats, varying from 2 to 40. Nowadays, the evaporated solvent is recovered by activated carbon or scrubbing methods since solvents too have become critical war materials.

Of the roll-coating machines, none is much used for textiles except the calender coater, which is invaluable for rapid, quantity coating. The calender can be used both for resin and for rubber coating; it is, however, typical of the rubber industry, and has only been used for the resins in the last few years.

The calender consists of 3 or 4 large rolls placed horizontally on top of each other. The uncoated fabric passes through the 2 bottom rolls and the coating compound passes through the 2 upper rolls emerging as a smooth film which is anchored to the fabric when fabric and film pass through the same roll. In general, calender coating applies a heavier film than spread coating; and it is, essentially, a single-pass machine. Though a calender coat may be applied directly to the fabric, it is usually applied over a prime coat laid on by spreader. This holds true unless the coating compound that is to be applied has excellent adhesion, such as is found in crude rubber, in butyl rubber, or in polyvinyl butyral compounds.

After calendering, the rubber-coated fabric, hanging in festoons from racks, is put into ovens to cure at temperatures of 250 to 270° F. When the cure is complete, the rubber film is no longer heat sensitive, for rubber, as compounded with a curing agent (usually sulfur), is a thermosetting material which sets in the cure. The use of thermosetting materials which can be cured enables the fabric to be coated at lower temperatures, but the thermoplastic resin coatings which cannot be cured must be run at very high temperatures. A thermoplastic with a high melting point is always chosen in order to avoid tackiness in the coated fabric at normal warm temperatures.

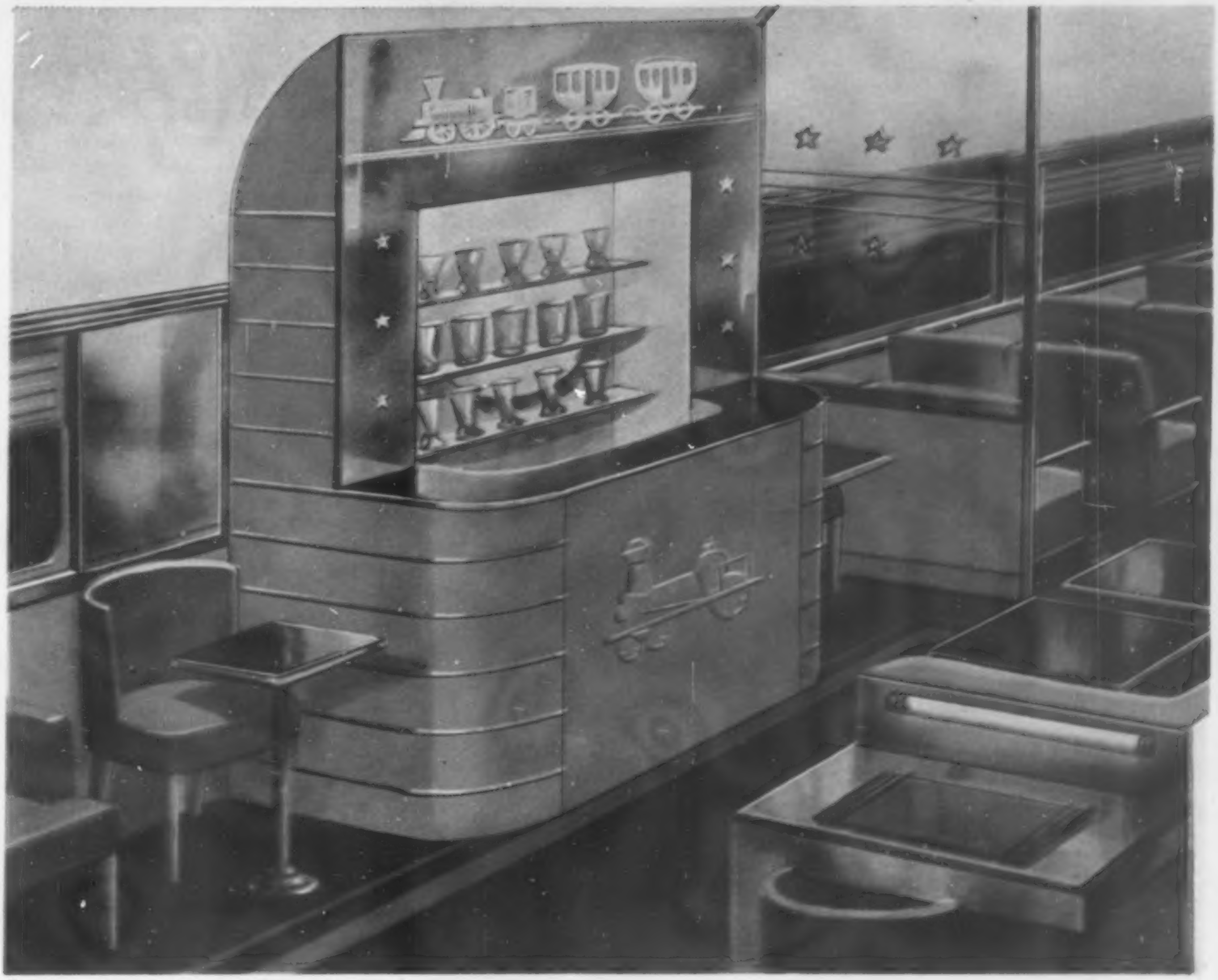
Traditional rubber coaters, or proofers, as they are called, find it hard to adapt themselves to the thermoplastic coatings which must be calendered at high temperatures because of the high temperatures they involve and the danger of burning out the calender bearings. Nevertheless, a great deal of vinyl resin coating is being done on ordinary rubber calenders without benefit of the water-cooled bearings once said to be essential for calendering vinyl copolymer resins. Other high-heat-resisting thermoplastics, such as ethyl cellulose, can also be calendered, but pyroxylin and oil coatings are unsuited for calender operation.

Dip coating, or coating in a bath, is an impregnation coating and is only used where both sides of the fabric are to be coated, as in the prewar oil-coated silks for raincoats. For the drying oils and for the alkyd-modified oil coatings used by the Army and Navy it is the best method. Only thin solutions can be applied by dip coating; for thicker coats the fabric must be recoated. Dip coating is particularly adapted for lightweight flimsy silks and rayons that will not stand the tension of the spreaders. It completely fills the interstices of a low thread count fabric; and it has been much used for waterproofing sheer rayon interlinings in Navy jungle cloth suits. Oil coating is also done by roll and spread coaters, the spread coater being the most common for

COLOR PLATE, COURTESY B. F. GOODRICH CO.


5

5—Hard wear is the lot of office furniture. As a result, plastic-coated fabrics such as this bright red polyvinyl chloride coated material are ideal coverings for desk chairs. 6—Postwar railroad cars will undoubtedly use increasing quantities of coated fabrics as upholstery material. Typical of this type of application are the furniture coverings in this lounge car



6 COLOR PLATE, COURTESY BAKELITE CORP. AND L. C. CHASE AND CO.

medium- and heavy-weight fabrics and for all fabrics coated only on one side. A thicker coat is possible by spread than by dip coating.

Three newer techniques in coating, all necessitating little or no solvent, are coming into increasing prominence now that solvents have become critical. All three are based on the dispersion principle, i.e., the mechanical dispersion of fine particles of resin or rubber coating in a liquid. In the spring of 1944 an announcement was made of the commercial production[2] of a polyvinyl chloride latex, less viscous than natural rubber latex, but in other respects similar. It is a dispersion of vinyl chloride resin in water without solvent. Compounding ingredients and plasticizers are added, and the dispersion is coated by standard spread- or dip-coating methods. The water is evaporated, leaving a layer of plasticized dispersed resin particles which is fused into a continuous film by heat at temperatures that range from 275 to 300° F.

In England spread coating of polyvinyl chloride is done by "the paste method." The polyvinyl chloride paste is a dispersion of polyvinyl chloride in a solvent plasticizer. The fabric is spread coated on an ordinary knife coater, and after it passes under the knife it moves over a steam bed where it gels into a solid mass at temperatures of 200 to 212° F. Another coat may be applied as soon as the first has gelled; and it, in turn, is gelled on the steam bed. After the required number of coats, the coating is fused into a continuous film by heating in an oven or under lamps to a temperature of 300 to 350° F. One of the great advantages of the past method is that a very thick coat can be applied. In experimental coating by the paste method, a film of 1 lb. per sq. yd. has been deposited with one pass of the material through the spreader. (A normal film varies from $^1/_2$ to 3 or 4 oz. per sq. yard.)

A third dispersion process is similar to the paste method except that an inactive organic solvent is used as the dispersing agent for the plasticized and compounded resin. The inactive solvent is said to impart better working qualities. This process takes advantage of the solvent action of plasticizers rather than active organic solvents. The solvent dispersion of the compounded resin is applied to the fabric by spread, dip or roller process. The solvent evaporates, leaving a gel which is fused by heat into a continuous film at temperatures of 350 to 360° F.

All three dispersion processes demand temperatures for fusing which are outside the range of most commercial cloth coating equipment and, therefore, they are not yet widely used. But when new equipment is again available and coating technique is developed, they will undoubtedly be common processes, which may materially lower costs.

One of the most unique coating processes is a method[1] of coating individual yarns with resin coatings. Cotton and rayon yarns are usually the base yarns, but linen, silk, glass

[2] Announcement by B. F. Goodrich Co.

COLOR PLATE, COURTESY B. F. GOODRICH CO.

7

7—Without coated fabric of the type used in this civilian pup tent, our troops might have been without such essential comforts as waterproof tents and the much-used ground sheet

yarns, nylon and other yarns have also been coated by this process, which utilizes properties of the base yarns and adds to them the intrinsic properties of the resin coating compound—tensile strength, color, fluorescence, waterproofing, flameproofing, verminproofing, acid or oil resistance—according to the resin compound used. Said by its owners to be an "impregnation and a coating," the process is essentially a dip coating of individual yarns.

The resin coating is compounded with plasticizer, solvent and pigment. From a creel the base yarn is drawn through the resin bath, through one of a series of shaping dies that regulates the thickness of the coating, and then into a drying chamber, where the solvent is evaporated. From the drying chamber the yarn is again drawn through the resin bath and a shaping die until the desired thickness of film is obtained. As many as 48 coats may be applied. As in all coating, 2 or 3 thick coats make for greater stiffness than several light coats. The yarns are usually waterproof, and can be made absolutely so; they are easily cleaned with water, are pigmented in all colors, and can be translucent or transparent. They are made in all shapes (round, elliptical or square) and in sizes from 0.008 to 0.03 in. in diameter (although fine yarns are not now being made, as most of today's production is for military uses, such as screening)

Indeed these coated yarns more nearly meet the claim of being tailor-made to individual needs than any other fabric yarns. Seventeen regular formulae for coatings are employed, each giving different properties. When one considers that each of these formulae can again be varied by a choice of several base yarns, the possible combinations are almost endless, and the variations very great. The yarns are woven or knitted on standard mill equipment, and made up into textiles for shoe fabrics, handbags and novelties, for auto upholstery, draperies and curtains. During the war, these yarns are replacing metal in military screening, and rubber in conveyor belts for dehydration plants; there is little available for civilian uses.

The military screening is an interesting application; cotton plies or rayon yarns are impregnated and coated with cellulose acetate butyrate and woven into insect screening on standard wire screen or textile looms. Lightweight and flexible—a great asset when it must be carried as part of the soldier's equipment, the screening withstands the high temperatures of the tropics, and is constructed of non-critical materials. Cotton was originally the base fiber, but when it became scarce, rayon yarns were found equally satisfactory. Another interesting military application is the coated glass yarn for electrical insulation on destroyers.

Coating materials

Before the war, the three general types of fabric coating were drying oils, pyroxylin or lacquer, and crude rubber. Base fabrics were cotton and silk, and small amounts of rayon. The resins which have been the backbone of military clothing were largely unknown as textile coatings, although cellulose derivatives—cellulose acetate, cellulose acetate butyrate and cellulose nitrate—had been extensively used as airplane dopes (a field outside the scope of this article). Small quantities of vinyl resins, alkyds, ethyl cellulose and synthetic rubber had been used, too, as fabric coatings, but they were known as special-purpose coatings.

Pyroxylin was widely used for the artificial leather upholstery and automobile trimmings we knew before the war, and for pocketbooks, luggage and household accessories, as well as for lighter weight fabrics for bookbinding, window shades and novelties. Crude rubber was used principally for coating rainwear, sanitary goods and hospital equipment, and for galoshes and footwear. Oil coatings in their deluxe form appeared as oiled silk shower curtains, window curtains

and novelties, and as raincoats and umbrellas. In their humbler form, as "oilcloth," they graced kitchen tables all over the world. To a less extent oil coatings were used in household textiles. All three types of coatings—pyroxylin, rubber and oil—were employed in industrial fields which lie outside the scope of this article. Of the three, pyroxylin and rubber were much the largest in volume.

A few days after Pearl Harbor all crude rubber was frozen. War had been declared on two fronts, and the industry was faced with the necessity of pulling a rabbit out of the hat and finding an immediate rubber substitute to outfit the greatest military expedition in all history. Although war was not unexpected, an immediate campaign in the Pacific had not been foreseen, and the Pacific campaign entailed many problems in clothing which did not exist in the temperate climate and known vicissitudes of the European theatre. Insec s, intense heat and humidity, mildew, the abrasion of fabrics in jungle marches, as well as occasional treks en route to the Pacific through Arctic wastes like the Aleutians, placed unprecedented standards before the whole textile industry and an unprecedented strain on their ingenuity. Gas warfare was thought to be more of a probability, too, in the Pacific than in Europe, and special fabric coatings had to provide against it.

As the Pacific campaign developed, interesting side lights appeared which were unrevealed in our immaculate scientific laboratories—such as the fact that tropical insects have a passion for some plastic resins, and poisons only enhance the flavor. Hence military specifications for coated fabrics were wide and varied. They included cold flexibility at temperatures of -20 to $-60°$ F., as well as freedom from tackiness and sticking at 180 to 200° F. (temperatures of tropical storage facilities), ability to be washed and sterilized, non-flammability, hydrocarbon resistance, resistance to mold, mildew and gases.

Neither pyroxylin nor the drying oil coatings met the severe requirements of the Navy and the Quartermaster's specifications, particularly in their flexibility and low temperature resistance. Confronted, then, with a stoppage of normal supplies and with the responsibility of equipping an army of several million men with proof clothing, the industry accomplished a remarkable conversion. The oil coaters, experimenting with alkyd resins, improvised a new alkyd oil coating which had better flexibility and better resistance to high and low temperatures than the old oil coatings. These alkyd-resin oil modified coatings were at first used in gas protective equipment, though they have now been superseded by butyl rubber. Alkyd oil coatings are still used for the Navy "foul weather gear" (consisting of a hat, either a long coat or short coat, and trousers).

The pyroxylin coaters cast about among the available resins for a waterproof coating which would fulfill Army specifications. The supply problem was constant. Availability was, therefore, the first criterion, since resins or synthetic rubbers which might have served, were continually being placed on priority for more critical war industries. To fill the huge military inventories, the supply had to be, first of all, plentiful. Vinyl resins answered this first requisite, and in the emergency both pyroxylin coaters and rubber proofers turned to the vinyl resins—polyvinyl chloride, copolymers of vinyl chloride and vinyl acetate, copolymers of vinyl chloride and vinylidene chloride, and polyvinyl butyral. A happier choice could scarcely have been made and, until very recent date when some of the synthetic rubbers became available in quantity, vinyl resins supplied the vast bulk of our military requirements.

In an analysis of the reasons for the excellent results of vinyl coatings, it must be remembered that the first essential of a coating is pliability and flexibility. Flexibility is difficult to obtain in the thermosetting resins; hence urea, melamine and the phenolics were automatically eliminated from the coating field except for use in special-purpose compounds. The coating resin then, must be, first of all, thermoplastic or of only limited thermosetting properties; second, it must be a thermoplastic with a high melting point to meet the high-temperature specification of the Army (fabric folded over with a weight on it at 180° F.). A thermoplastic with a low melting point might soften in the jungle heat. The third qualification of the coating resin is resistance to intense cold (as low as $-60°$ F.), which eliminates still other resins.

Of the remaining thermoplastics, chiefly the cellulose derivatives, the vinyls have better resistance to low tem-

PHOTO, QUARTERMASTER CORP, UNITED STATES ARMY

8

8—Both in the Army and Navy, the most important single item of proof clothing is the raincoat and the numerous variations which the raincoat assumes—parka and trousers, poncho, "zoot suits" and wet weather gear

peratures; although they do stiffen in the cold (and that has been their disadvantage in military clothing), they do not crack like the cellulose nitrate coatings. Another asset of the vinyl coatings—and an important one in a tropical jungle expedition—is that they do not mildew as do the pyroxylin coatings. Compared with the rubbers, both crude and synthetic, vinyl resin coatings have superior weathering and sunlight aging properties (poor weathering has, in fact, been the bete noire of all the rubbers except neoprene and butyl). In flex and abrasion resistance, too, vinyl coatings are superior to the rubber coatings. In other properties—resistance to water, oil, acids and alkalis—vinyl resins compete well.

For certain purposes, of course, crude and synthetic rubber coatings are superior to vinyl resins, particularly where low temperature flexibility is important, as in the crash boats carried by Army and Navy planes, and in other inflatable goods where rubber makes for greater ease in manufacture. Originally it was thought that the vinyl resins had less ability for holding gas than rubber, and that rubber was essential for all inflatable goods, but this theory seems to be exploded. The experiment in vinyl resin coatings proved eminently successful, and the bulk of military coated clothing and equipment was therefore converted from natural rubber to resin coatings.

Because of the supply situation at the beginning of the war, and the fact that neither crude nor the synthetic rubbers were available except for the most essential coatings, the rubber proofers also turned to the vinyl resins. At the outset the technique of processing the vinyl copolymer resins caused grave difficulties. They were particularly difficult to calender. Since the vinyl copolymer resins remain permanently heat sensitive and cannot be cured, resins which soften at 270 to 340° F. are used, and there was danger of burning out the bearings or warping the calenders. The water-cooled bearings recommended by the material suppliers were unavailable during the war, and impelled by the huge military inventories to be filled, many of the proofers learned to calender the copolymer resins regardless of difficulties. Others turned to spread coating instead of calendering. In spread coating, too, the resins containing more than 93 percent vinyl chloride were difficult, as they needed special solvents which were frequently unavailable. Then, too, the coating solutions used were low in solids content and therefore necessitated more coats to make the film.

Because of the early troubles in calendering the copolymers, the rubber proofers searched for a resin which could be calendered and processed like rubber. The end of this quest was the finding of polyvinyl butyral, an ideal resin in the rubber world, as it processes in every detail like rubber and has excellent adhesion. The original polyvinyl butyral was so highly thermoplastic that when the fabric was heated to a temperature of 180° F. the coating soaked into the fabric and vanished.

A thermosetting polyvinyl butyral was then developed[3] which could be cured like rubber and made permanently heat resisting. Adapted as it is to the methods of a traditional industry, polyvinyl butyral is still the outstanding resin for rubber plants, making use of mills, calenders and curing ovens, and of a trained personnel. In the first year in which it was produced, one material supplier estimated that 3 million pounds went into coatings, a replacement of several million pounds of rubber. (It must be remembered that a notable advantage of resin coatings is in cutting down the fabric weight.)

[3] Developed by Hodgman Rubber Co. and Monsanto Chemical Co.

Of the vinyl-chloride-acetate copolymers, those containing 93 percent or more of vinyl chloride are the most suitable for textile coating. They have a higher softening point and can be more highly plasticized without becoming tacky than the copolymers containing less than 93 percent vinyl chloride. In both high and low temperatures they maintain their flexibility better than the low chloride content copolymers, and they also have better abrasion and flexural fatigue resistance (i.e., the amount of flexing they can stand before breaking). Hence they are better adapted for all-purpose coating—for upholstery as well as for Army raincoats.

The original coating worked out by the Quartermaster Corps for Army raincoats was based on 93 to 100 percent vinyl chloride. When the low temperature requirement is − 40° F. or lower, the high chloride content copolymers are always used, but for less severe temperature specifications a 50–50 mixture of the two has been tried and found satisfactory. The lower chloride content vinyl copolymers have only come into use for the Army because of the supply situation and the fact that, when first the industry went into production on Army raincoats, resins in the 93 percent or higher vinyl chloride category were needed for Navy insulation of electrical cables. Proofers somewhat favored the low chloride content copolymers too because they were easier to handle and did not require such high temperatures in the calendering process.

While the lower chloride or "lower softening" plastic resins are excellent in many fields such as paper and metal coatings, the material suppliers stress the fact that they are unsuited for most textile applications, particularly for such uses as hospital sheeting, crib sheeting and bathroom accessories which must be constantly sterilized. As these resins soften in hot water, they are unfit for many such consumer uses, and their poor flex resistance also unfits them for use in upholstery. Though they are well adapted to the fields for which they were originated, the material suppliers say they are not adapted for general-purpose fabric coatings.

In the conversion period and for as long as the supply situation remains critical, however, there is danger that some manufacturers will use the more available lower-softening vinyl resins for general-purpose coatings, with resultant consumer prejudice. Since the material suppliers are incapable of controlling the end uses of their products, and as the public is still ignorant of plastics and molding procedure, fraudulent claims are perpetrated in coatings as in other plastic applications, the most recent being the advertisement of "a new plastic coating material never offered before" which, on investigation by the material supplier, appeared to be reworked pyroxylin, which had been made from scrap moving-picture film.

In the early stages of the war, vinyl resins of all types did an invaluable job for our Armed Forces in supplying the bulk of their waterproof, coated clothing and equipment. Most of the crude rubber and neoprene which was then available for coating was being allotted to the Navy, the Corps of Engineers or to C.W.S., and the bunas and butyl were not yet in large scale production. Without the vinyl resins our troops might have been without such comforts as waterproof tents, groundsheets and raincoats—no small comfort to one who has to struggle with wet tent flaps and sleep in wet clothes. As fabric coatings they are notable for flex, fatigue and scuff resistance, and for their excellent aging properties.

Although the rubber proofers in the coating industry had successfully converted to vinyl (*Please turn to page 182*)

OFFICIAL U. S. NAVY PHOTOGRAPH

1—The best way to teach a sailor to recognize a ship such as this 10,000-ton cruiser of the "Cleveland" class is to show him the real article, over and over again. Since this is impossible, plastic models serve as stand-ins

A "Cleveland"-type cruiser in miniature

MORE and more dispatches from the Pacific tell of stirring and decisive victories over the Japs by United States warships "manned largely by Midwest farm boys," most of whom had never seen an ocean, let alone an ocean-going war vessel, before they entered the Navy. The work of the Navy in training these recruits and molding them into fighting units that rank among the most efficient in the world has been one of the outstanding features of American wartime organization.

Playing a prominent part in this task was the Training Aids Division of the Naval Bureau of Personnel which has procured and distributed a wide array of audio-visual training aids, including movies, slides, small- and large-scale models, and many mechanical devices which have speeded instruction procedure and made it far more thorough. All through this program, the Navy felt the need for small models that reproduce in exact detail the major ships of the fleet. Hand-made wooden models were tried and found to be only partially satisfactory—first because they were inaccurate, incomplete, and not uniform; second because their fabrication was slow and expensive.

Thus it was that the Navy turned to plastics. The first result of this move is one of the most remarkable and complicated jobs of fabrication and assembly ever turned out by a plastics molder. It is a 6 ft., 4 in. long replica of a 10,000-ton cruiser of the "Cleveland" class, complete down to deck chocks and anchor chains. Produced in sizable quantities for various Navy training establishments, the model—made of cellulose acetate—is known by the Navy as a "familiarization trainer for seamanship, gunnery and "communication classes." Designed from actual blueprints of "Cleveland"-type cruisers, it embodies practically perfect reproductions of the ship and all its equipment with the exception of such devices as are claimed as naval secrets.

The construction of this miniature ship and models of smaller vessels was a logical outgrowth of the Navy's belief that the best way to teach a man to recognize a ship is to show him the real article, over and over, under various conditions. Since, for obvious reasons, this approach cannot be used extensively, a more practical method was devised—that of letting models stand in for the real articles. A ship—in three dimensions, accurately built to scale and brought down in size—can be handled and studied at will in a variety of ways. It can be viewed from any angle under any lighting condition. With a little ingenuity on the part of the instructor, it can also be put through the characteristic movements of its life-sized counterpart.

"Passing them around" (Fig. 6) is a common training method, and an effective one when done correctly. The best procedure in this case is to have several models available for study at the same time. Thus, all members of the class are kept busy. When only one miniature ship is shown at a time, the greater portion of the class must sit idle while the single model makes the rounds.

Another method of using these models is to place them in glass-fronted, numbered compartments. Push buttons set in a panel at the top are hooked up electrically with the show cases containing the tiny ships. The idea is to name the ship, then press the button which carries the number of the ship in question. The correct name of the vessel appears in a lighted window positioned above the button, thus serving as an immediate check upon the student. Yet another method of training with these models is shown in Fig. 7. Set out on any fair-sized flat surface—in this case a range estimation table—the models can be moved about to demonstrate tactical maneuvers, formations, target angles, bearings and other phases of naval training. Used in this way the small ships can be viewed at various angles and under dif-

ferent lighting conditions as required. With reversed binoculars, the illusion of distance can be created.

The model of the 10,000-ton "Cleveland"-type cruiser which is composed of nearly 1000 parts and requires 40 dies, was produced by injection molding of cellulose acetate. Having a weight of approximately 8 lb. 6 oz., the ship is believed to be one of the heaviest as well as one of the largest and most intricately assembled jobs of its kind that has ever been turned out.

The ship is known by the Navy as a waterline model due to the fact that the hull ends at what would be the waterline in the actual warship. Mounted on a plywood panel, the model thus appears as it would in the water. All dimensions are on a scale of $^1/_8$ in. to the foot—even the several types of guns and such incidental equipment as the tiny figures of sailors, $^3/_4$ in. high, which show the precise relationship of each item of construction and armament to the men who man the ship.

All assembly work on the model ship of the "Cleveland" class is done by the molder, with the exception of the rigging which is put on by the Navy. Parts are accurately fitted together and, in most cases, cemented. However, numerous parts are movable on split washers. These latter include the turrets of the larger caliber guns, searchlights, firing towers, plane catapults, the crane at the stern, bridges and other units.

In planning the complicated assembly of the ship, the molder followed, in the main, the same system of "prefabricated unit assemblies" used in the major shipyards. There are seven sub-assemblies which are completed and ready for use when the hull is complete. The hull itself is in ten parts. With walls approximately $^1/_4$ in. thick, these several molded parts have flanges to facilitate bolting to the wooden base. The hull sections comprise one bow section, one stern section and eight side sections. The deck is divided into six parts.

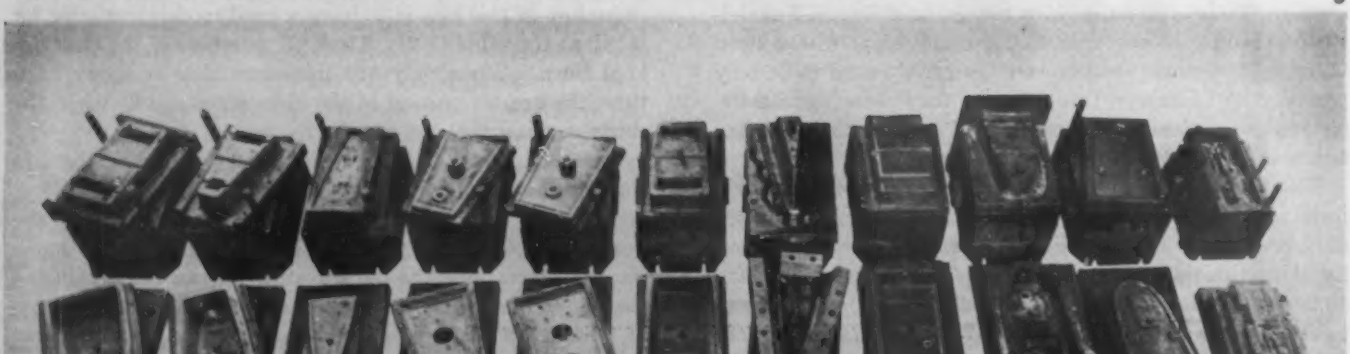
Some idea of the completeness of the job can be gained from a résumé of various items of armament, construction and

PHOTOS, COURTESY LIVINGSTON PLASTICS CORP.

2

2 and 3—The 1000 or so parts that comprise a model of a 10,000-ton cruiser are injection molded of cellulose acetate in 40 dies. Most of the molds produce more than one part. For example, 3 different-sized gun barrels are included in one die. In addition, many of the parts are duplicated—ladders and sections of the boat rail

3



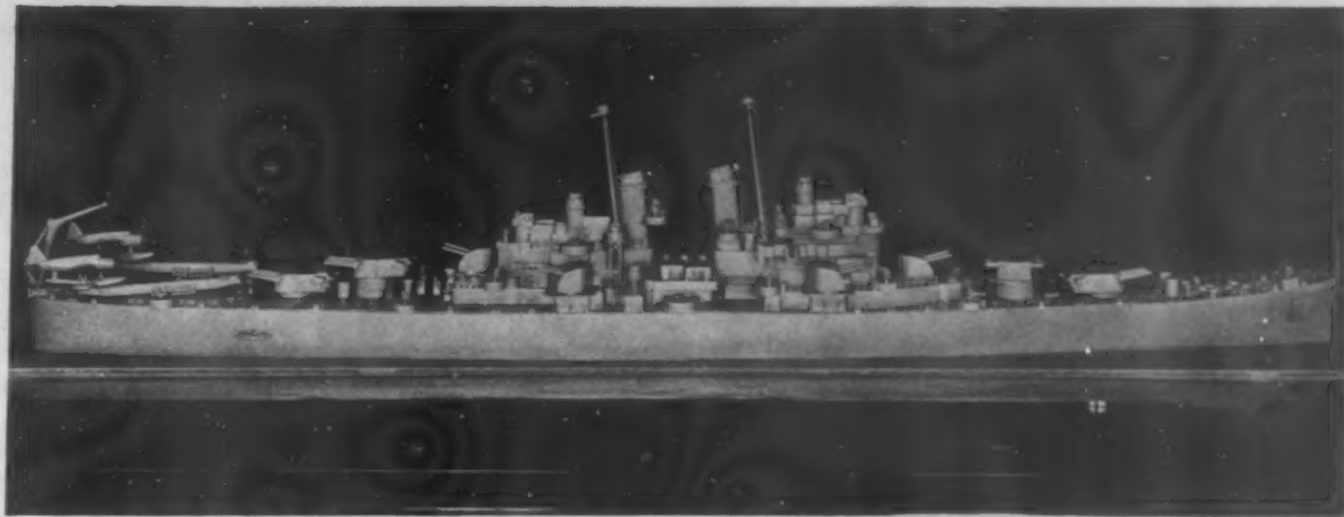


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PHOTO NO. 4 COURTESY LIVINGSTON PLASTICS CORP.
PHOTO NO. 5, OFFICIAL U. S. NAVY PHOTOGRAPH

5

4—The system of "prefabricated unit assemblies" used in shipyards was followed in the complicated assembly of this model ship of the "Cleveland" class. There are 7 subassemblies which are completed and ready for use when the 10-part hull is finished. 5—The size of these models—6 ft. 4 in. in length—is best appreciated when compared with an average-sized man. 6—One of the most common training methods consists in passing the models around the classroom where they can be examined at close quarters and handled by the students

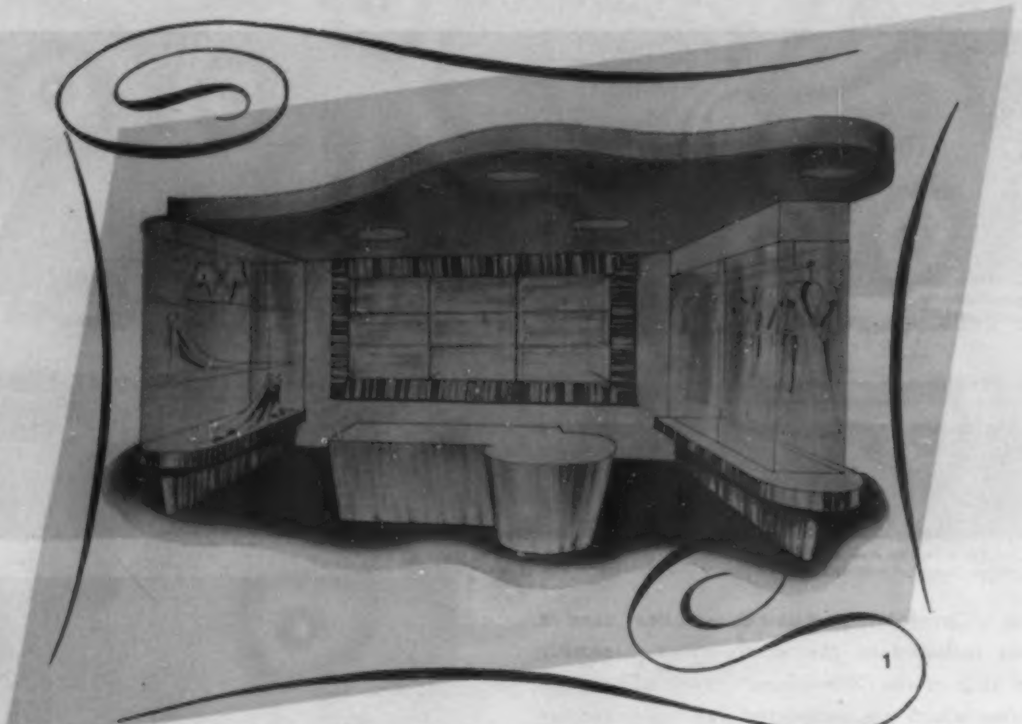
equipment. There are twelve large caliber guns, mounted three each in four movable turrets, and twelve 5-in. guns, mounted two each in six movable turrets. Anti-aircraft guns of large caliber include a number in mounts of two. Then, there are many smaller machine or anti-aircraft guns in single stationary mounts in various parts of the ship. The largest guns have barrels a little less than $1\frac{1}{2}$ in. long and $\frac{1}{8}$ in. in diameter, while the smallest have barrels only about $\frac{1}{2}$ in. long and around $\frac{1}{32}$ in. in diameter. The model has two masts, 9 in. high, which taper from $1\frac{1}{8}$ in. in diameter to $\frac{3}{8}$ inch. On top of these are mounted the lookout posts or "crows' nests." Two funnels are 4 in. high and $1\frac{1}{2}$ in. at the point of widest diameter. Two plane catapults at the stern, also movable, have replicas of two scout or observation planes.

Equipment includes such details as lookout chairs, paravanes $1\frac{1}{4}$ in. long for cutting cables of magnetic mines, running and stern lights, miniature lengths of chain wired to deck brackets, two-prong anchors $\frac{3}{4}$ in. long and $\frac{7}{8}$ in. wide, winches $\frac{1}{2}$ in. wide and $\frac{5}{8}$ in. high complete down to handles $\frac{1}{8}$ in. long, tie-downs for flag lines, the deck chocks of which there are twenty-two, and the movable searchlights $\frac{7}{16}$ in. in diameter. The rail, surrounding the entire ship and molded and assembled in sections, is $\frac{1}{2}$ in. high.

6

Finish of the entire ship is in battleship gray. The original plastic material is in that color, but the entire job is given a final coat of paint to obliterate any dirt or marks left after the assembly is completed. Figures of the crew members, placed at various stragetic parts of the ship, are in white for contrast.

Given the Navy's blueprints and specifications of an actual full-sized ship, the molder was faced not only with the problem of how to tool up, how to assemble and how many molds were necessary, but with the need for as much speed as possible. It finally was determined that the job could be done with a total of 40 dies. Most of (*Please turn to page 194*)



1

Display units for tomorrow

It may be a handbag, a pair of gloves or a man's shirt. No matter what the purchase, successful or not, the average shopper is almost certain to leave the store with aching feet and frayed nerves. First there is the problem of finding the proper department in the welter of unrelated merchandise that characterizes all too many of our department stores—struggling in and out of elevators to reach the hats, shoes and dresses which are diabolically scattered on widely separated floors or the blouses that have been arbitrarily divided into two departments. Even when the proper section of the much sought department has been located—the suede section of the glove department, for example—and the sales girl informed of the size, color and style of the merchandise being sought, the routine is only half finished. Scrambling past other clerks who almost block the small space behind the average counter, the girl entrusted with your purchase must search through drawers, shelves or racks for the article in question. Depending on a combination of luck and the sales girl's memory of the latest rearrangement of the stock—labels on drawers and bins being most often non-existent—the shopper may be anywhere from 5 min. to half an hour late for her luncheon appointment.

Fully aware of these struggles of shoppers—and sales people—but prevented by wartime restrictions from taking

1—The flexibility of an interior display is a matter not only of design—but of weight. Use of plastic-bonded plywood for the base of these show cases and for the counter facilitates the moving of the units to fit seasonal merchandising plans. 2—Maximum display and storage space are combined in this sectional wall display unit

ALL DESIGNS AND RENDERINGS, COURTESY ROSS-FRANKEL, INC.

2

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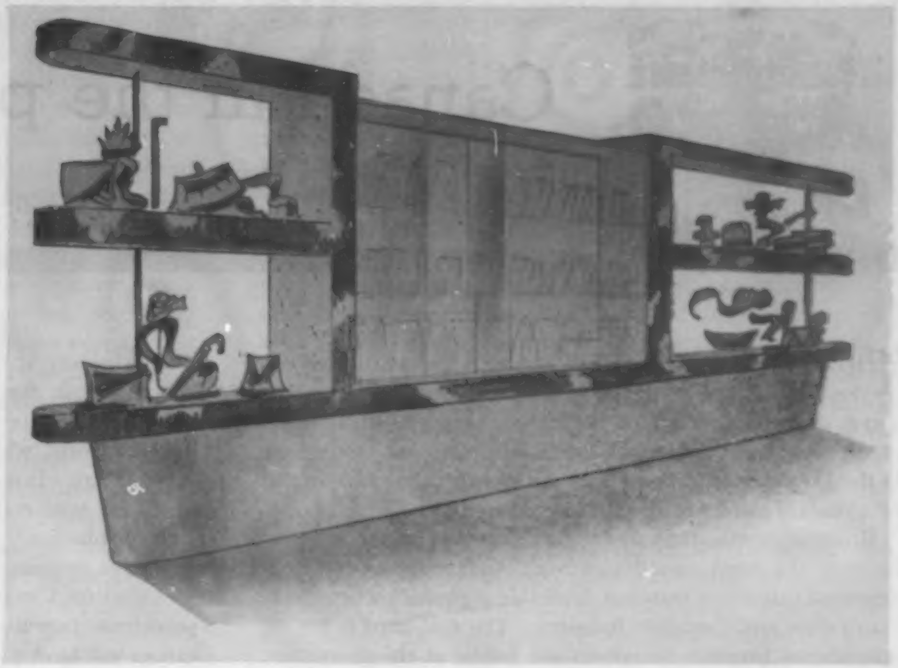

3—Rather than display but a few items of merchandise and secrete the rest below the counter, many store managers would prefer island displays such as this which combines display and storage space in the counter section. Plywood as a base material and molded plastic edging reduce the weight and make moving easy. 4—Again storage and display space are combined in sectional wall units which can be expanded at will

prompt remedial action, store managements are incorporating the solution of these difficulties in their postwar modernization programs. According to Ross-Frankel, Inc., designers and builders of stores throughout the country, the future face lifting of retail shops will not be powder and paint applications but involved and drastic rearrangements.

This company considers its work to extend beyond the planning and erection of attractive displays. With a list of all the articles sold by the client store, these designers first work out the rearrangement of the merchandise so that related articles will be sold at adjacent counters. Thus gloves and handbags will be close together in their arrangements; blouses and suits in nearby departments; dresses, hats and shoes on the same floor. Only then does the beautifying process begin.

All this does not mean that there will be no restrictions on the modernizer. With space a very vital factor, more so today than ever before because of stepped-up volume, every counter design and department plan will be measured against the yardstick of maximum display for minimum space. To meet this standard, this company of designers anticipates using plywoods and various other plastics materials which it has found from past experience to have desirable weight and forming characteristics. With these materials, designs can be so "turned" that every inch of space is of value. For example, a column—round or square—can be transformed from an ugly useless obstruction to an attractive valuable display by the installation, at any height, of a curved and stylized plywood backboard and shelf.

In all their designs for a given client, these designers strive toward an underlying harmony in the displays and counters. This not only enhances the beauty of the store but gives the management greater freedom in its seasonal promotion. Thus, as summer approaches, the space devoted to coats can be reduced to a fraction of its midwinter size and the adjacent dress department expanded accordingly. It is here that the light weight of the plywood and other plastics from which these displays are expected to be constructed becomes of importance. With plywood as the base material, it would be but the work of a few moments to turn the display shown in Fig. 2 so that it could match with another similar counter and thereby double the size of the lingerie section. And just as the use of plywood in the curving side panels, the counter front and other display space of (*Please turn to page 198*)

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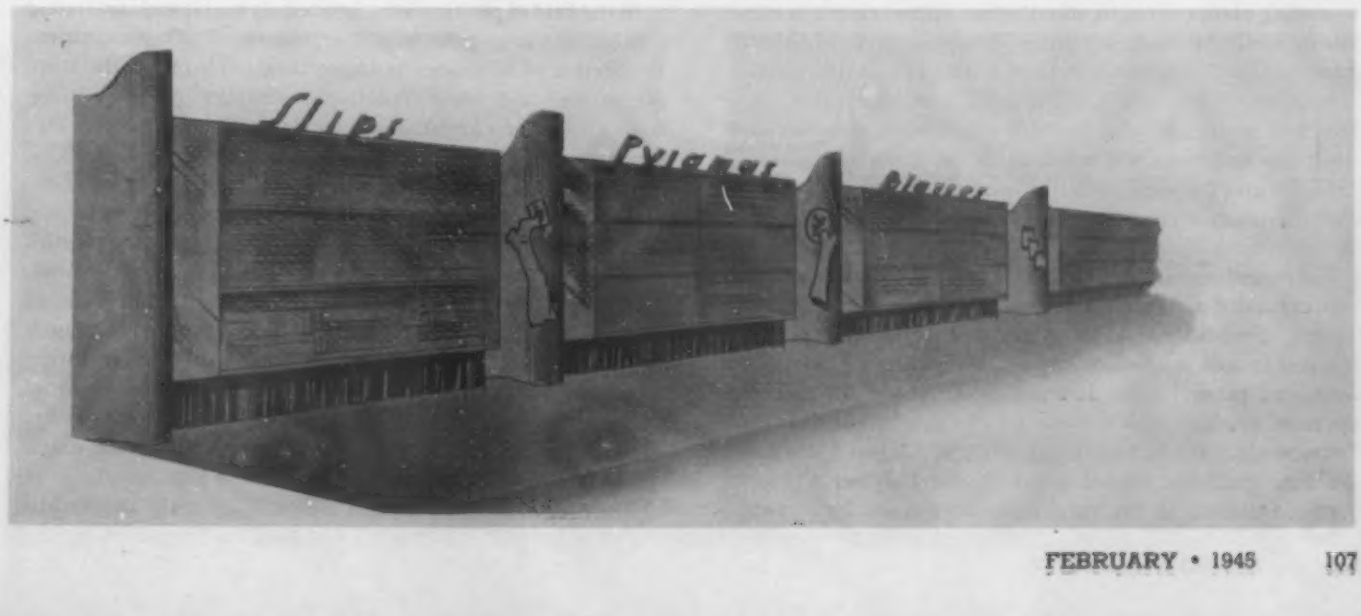


Canada in the postwar years

by KIM BEATTIE

THE future of the plastics industry in Canada is still in doubt. No one can be very sure just how far plastics are going, or in what direction. Plastics have played a dominant part and exerted tremendous influence on war production in the Dominion, but the strides the industry may take in the first years of peace are difficult to predict.

However, some attributes of the future are clearly evident to even the most casual observer. Certainly a very high degree of interest is manifest in all things plastic by the Canadian public and Canadian industry. The real need is for an educational program to inform the public of the properties, variations, abilities and the place of plastics in general living. Such a development will probably come about through cooperation of Canadian industry and such plastics enthusiasts as George Scribner, president of the Society of Plastics Industry in the United States. Long an advocate of a large-scale program of public education in order to bring a clearer conception of plastics before the people of both Canada and the United States, Mr. Scribner is in close touch with the industry in the Dominion. The educational propaganda idea is inspired by a fear that the public may judge plastics as a whole on the basis of its experiences with some inferior article—such as certain types of plastic dishes and kitchen ware—and condemn the entire industry for the fault of only a few of its members. There is also the danger of the public accepting without question some of the fantastic claims that once were made about plastics, thus creating a perfect situation for disappointment which might act as a set-back to the future development of the industry.

As in the case of many industries, 5 years of war have given a greater impetus to the plastics industry in Canada than a quarter century of peacetime progress could ever have accomplished. Canada's activities in the plastics field are still largely confined to fabrication, with the bulk of her raw materials still imported. But the war has forced great extensions to existing plants, brought about a vast improvement in engineering skill and manufacturing knowledge, and added the names of about 40 firms to the prewar list of Canadian plastics fabricators. There are only 4 or 5 companies that produce raw materials, and the bulk of molding powders and other raw materials will continue to be imported from the United States for some time to come. However, it is evident that the plastics industry already has a firm foundation in the Dominion.

The manufacturing facilities for phenol-formaldehyde have been expanded and a new plant has been erected for the manufacture of additional vinyl compounds. Other war-forced progress is seen in the new production of lignin plastics and laminated paper by the Howard Smith Paper Co.; in the increased production of acetates for clothing by the Canadian Celanese Co.; in the huge nylon plant at Kingston, Ontario; the new synthetic rubber plant of the Polymer Corp. at Sarnia, Ontario; in the vinyl resins turned out by Shawinigan Chemicals; the V.Y.N.W. by Canadian Resins and Chemicals; and in the greatly increased production of phenol-formaldehyde-type adhesives and varnishes by the Canadian Bakelite Corp., who will surely use considerable polystyrene in the future. It may well be that after the war nitrate plants which are now making explosives, will produce the nitrates used for plastics.

A large increase in the use of synthetic resin adhesives is predicted for Canada the moment industry is reconverted to peacetime pursuits; waterproof adhesives for boats and canoes will have widespread use. During the past four years, a new branch of the plastics industry was created in Canada for the fabrication of transparent plastic fairings, canopy panels and noses for trainer and combat planes. In the early period of this effort, with only trainer aircraft being built in Canada, shapes were simple. However, sufficient experience was gained in the technique of this type of work to enable Canadian manufacturers to supply in full and without delay the much more complex plastics parts contained in the Mosquito and Lancaster. This experience in shaping parts from cellulose acetate or methyl methacrylate sheets by drawing, blowing or by whatever other technique is employed, will be easily adapted to peacetime articles.

Before 1939 there was but one plastics extrusion machine operating in Canada. Today at least 6 machines are producing rigid and flexible tubing for war and essential civilian production. An interesting criterion of increased activity among plastics molders is the condition of a single tool works, under manufacturing license, which has 4 injection molding machines under construction, with early delivery awaited by Government-specified companies, and at least 6 other machines upon which construction has been started although none have as yet been allocated to firms engaged in war work. There have likewise been numerous inquiries with respect to compression molding equipment.

In the field of plastic resins, bonded plywoods and laminates, Canada has kept pace with the progress of other countries. Production of laminates has more than tripled since the start of the war and, very recently, production of low-pressure resin glass fiber combination parts was launched in the Dominion. Before the war the largest single use of vinyl resins in Canada was in the manufacture of automobile safety glass. Today the production is devoted in its entirety to the war effort. However a great impetus in this branch of the plastics industry is predicted for the years after peace is declared. The search for materials to replace rubber in hundreds of articles has also served as a stimulus to yet another branch of the industry. The advancement in general manufacturing "know how," brought about by conditions following Pearl Harbor and by the rubber shortage, has been remarkable—especially as it affected the production of rainproof coats, ground sheets and covers for all manner of equipment.

The vinyl chlorides are still almost completely assigned to

war work, but it is expected that greater quantities of the material will be available in the not too distant future, and a substantial peacetime market is guaranteed. Diversion of nearly all the available cellulose acetate, ethyl cellulose and polystyrene to the war effort has also held back the paper box companies. However, it is the avowed intention of this industry to supplant its prewar lines with rigid transparent boxes at the earliest possible moment. Eight of Canada's major paper box manufacturers have stated this intention as an immediate postwar move.

Canadian fabricators, extruders and molders are, as a man, looking toward some let-up in wartime restrictive measures on plastics materials. Those measures were applied at a very early date in Canada, almost as soon as it was evident that the Dominion's very young plastics industry would have to be quickly and almost wholly converted to the production of war parts and certain civilian items essential to the electrical, communications and transport industries.

Control of the distribution of Canadian-made molding powders, resins and laminates was vested in the office of the Chemical Controller. With the advent of Pearl Harbor and United States' declaration of war, the Canadian Chemical Controller, in conjunction with the United States War Production Board, took over complete allocation of American-made plastics materials upon which the Canadian plastics industry depends so extensively. The Canadian Chemical Controller, at about the time of Pearl Harbor, called together representatives of the various phases and branches of the Canadian plastics industry and formed the Plastics Advisory Committee.

There has been excellent cooperation between the industry and the Chemical Controller throughout the war, and plastics have been playing an even greater part in the fight. Several molders are supplying full requirements for radio and communications—producing parts that will correspond closely with items needed in peacetime production. Intricate designs and molded-in inserts called on new skills and mold designs; molding to exact specifications and close dimensional tolerances demanded the highest degree of ingenuity and engineering practice. From all this and from the need for saving critical metal in such things as periscope housings, instrument cases, binocular parts, Sherrill compasses, No. 69 hand grenades, and scores of similar items, the Canadian plastics industry has gained invaluable experience with which it can face the competitive markets that will come with the advent of peace.

There is already evidence that additional releases of raw materials to the industry for civilian production may materialize in the not too distant future. Control authorities have let it be known that the supply of both phenolics and ureas should become more readily available. Supplies of phenolic molding compound have already been released for the molding of radio cabinets, but use is not yet being made of the compound, as most manufacturers have their plants completely tied up with war orders. The supply of thermoplastics materials is still rigidly controlled and allocated for war uses—the shortage arising from the absence of sufficient cellulose acetate flake and plasticizer. Production of the latter has been seriously affected by heavy requirements of dimethyl phthalate for the insect repellents used in the tropical war zones. The demand for benzene for aviation gasoline also keeps the supply of polystyrene very tight.

Canadian plastics companies foresee good markets and considerable business in making and marketing "proprietary" lines—products for which the manufacturer controls the designs, molds, the manufacturing and the distribution. Toys and plastic razor sets are examples of proprietary items. The "stock mold" products—radio parts, buttons, etc.—and articles which other manufacturers will use as a part of a complete product, are expected, in combination with proprietary products, to form the bulk of the postwar plastics business in Canada. A spectacular increase in the manufacture of such plastics articles over the prewar production is predicted. The confidence which is expressed in the future of plastics in Canada seems justified. The industry has learned new techniques and new efficiency in handling raw materials. An effort is being made to hold all plastics parts to the very highest standards as insurance against public distrust and misunderstanding of the use and place of plastics. With an educational program to back up these progressive views within the industry, there should be little trouble in the creation of new markets. The day when plastics products were looked upon as novelties, without too much practical use, is well past; and the record of Canadian plastics in war stands as an encouraging augury for the future of the plastics industry.

One of the most favorable (*Please turn to page 196*)

1—Fixed-pitch laminated birch propellers proved invaluable in meeting the demands for great numbers of trainer aircraft. A worker is shown checking the pitch of a propeller. 2—Experience gained in fabricating plastics bomber parts has given Canadian manufacturers confidence for the future

2 ALL PHOTOS, COURTESY CANADIAN NATIONAL FILM BOARD

3

PHOTOS, COURTESY BEN HUR PRODUCTS, INC.

Emphasis on beauty

The "where" and "how" of displaying feminine accessories are important questions to both consumer and retailer. Recognizing this fact, one manufacturer concentrates his efforts on answering these problems—making the sale of his products incidential to the promotion of beauty

EVERYONE who goes into the business of making and selling novelty merchandise and feminine accessories takes competition for granted. If the company deals in quality goods, it expects to have low-priced imitators picking up its ideas as soon as they show promise of widespread popularity. Forewarned, these originators sometimes try to safeguard their products with patents. More often they resign themselves to a quick profit and the abandonment of an item as soon as it is copied by others, in favor of some entirely new accessory.

There is a difference, however, between accepting and encouraging competition. And encourage competition is exactly what Ben Hur Products, Inc. does. Faced with the sure knowledge that its quality plastic combs and hair accessories would soon appear on the 5 and 10 cent counters, this company decided to provide its own competition. So it is that the handmade products of this manufacturer first appear in the quality stores at prices ranging from 1 to 10 dollars an item. About 6 months later, when sales of the expensive combs have indicated the more popular styles, the company redesigns those plastic items that promise quantity appeal so that they can be injection molded rather than handmade and offers them to the public at a cost of from 10 cents to a quarter.

With a background of more than 20 years in the molding and merchandising of plastic utility combs of all sizes and colors—dressing combs, pocket combs, vanity combs, men's combs, tuck combs, side combs and back combs—as well as knitting pins, crochet hooks and more or less standard barrettes, it is not surprising that this company should think of underselling its own products. What is more to be wondered at is the entrance of the firm into the quality market.

Setting the fashion

It is the contention of Mr. Behr, president of the company, that before an inexpensive item is successful in the syndicate market it must first be established and popularized in the better stores. In other words, outside of the larger cities, the Jones' still set the fashion. Until the Mrs. Jones of a particular "Middletown" gives her sanction to a style, it is doomed to failure in the territory over which she holds sway. And Mrs. Jones buys at the higher priced stores. Thus there is little hope for any type of novelty that starts out at the syndicate store level.

Substituting Cafe Society or a similar group for Mrs. Jones, a like situation exists in the larger cities. The society page or the fashion magazines are quick to publicize every new mode taken up by the fashionable. Once a new style in hair accessories, for example, is shown to be more than a momentary whim of this fashion-conscious group, the comb, barrette or similar product is quickly publicized in magazines that reach the middle group. From there it is but a step to the syndicate store counters.

Long years in the fabrication, molding and merchandising of hair accessories has also shown the company that the quality

market can only be tapped in the first sweep of popularity of a given style. As with products of all types, once a certain style of comb appears on the 5 and 10 cent counters it will seldem be reproduced as an elaborate, handmade item. The merchandising price trend is always downward—rarely the reverse.

The reproduction of an expensive handmade plastic hair ornament in an inexpensive injection molded model does not, surprisingly, have an adverse effect on the sale of the better quality merchandise. The women who willingly spend as much as 7 dollars for a rhinestone studded comb are interested in the effect of the moment. They do not intend the item to be a permanent part of their ensemble. By the time a similar comb appears in the syndicate stores, shorn of necessity of much of its glitter and delicate working, these forerunners or initiators of fashion are ready for a change. In fact, since 6 or 8 months usually elapse between the appearance of the quality item and the inexpensive molded products, the women who purchased the original hair accessories have already discarded the comb in question for a newer novelty.

Sell beauty, not combs

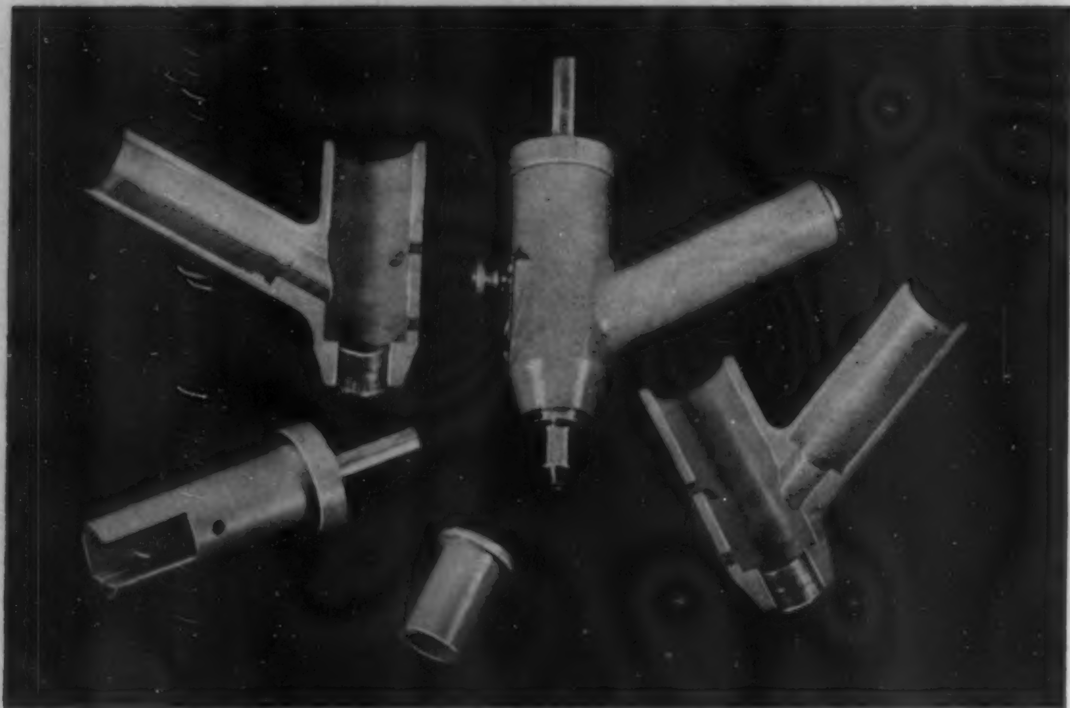
But even with skilled help to cut the expensive combs and the other ornaments from the plastic sheet stock and the injection equipment to copy these same accessories in less expensive molded form, there remains the problem of deciding what type of hair ornament will be popular during any succeeding 12 months. Rather than risk guessing what hair stylists will evolve for the coming season, this company concentrates its efforts on selling beauty first, combs second.

The first step in this direction is the creation of hair styles. Keeping in mind the trends of the past few seasons, Mr. Behr has selected for the winter and spring season extremely simple styles of hair arrangements that take a minimum of care. It is his feeling that no woman, no matter what her social or economic level, has the time to go several times a week—or even once a week—to the hairdresser so that he can arrange her curls in an elaborate coiffure.

Model heads are selected for the Miss and Junior Miss; their hair carefully arranged in these simple, easily managed hair styles. The company then suggests the endless variety that can be achieved with these basic hair arrangements—and it is here that the selling of combs and other hair accessories begins. For daytime and office wear there are tortoise shell combs or barrettes. Again, if cocktails are in order, these unadorned ornaments can be replaced by brilliant-studded tortoise shell combs or pearl-decorated accessories. Finally, for the evening, the same hairdress will assume an entirely different appearance if transparent Spanish combs inlaid with brilliants are tucked in behind the ears or at the nape of the neck.

In all this work the company keeps in constant touch with the arbitrators of fashion. Every design for a new comb or similar hair accessory is referred *(Please turn to page 192)*

All hair ornaments are first hand-cut from celluose acetate sheet material. After a lapse of 6 or 8 months the more popular models are redesigned so that they may be injection molded for sale on the syndicate store counter



1—Center scopes—such as the one shown here surrounded by its component parts—insure greater accuracy in the multiple production of identical parts. The body is split in half to show the uneven wall thicknesses which had to be molded in this single part

Precision is seldom an accident

by E. F. LOUGEE*

SUPPOSE you are in an airplane 30,000 feet up in the air. Directly beneath you is a battleship. How big does that battleship appear to be to the naked eye? As big as a pinhead? As big as a washboiler? Or, as big as a house? Ask a dozen persons this question and you'll get twelve different replies. Actually, the battleship would appear to be about $^5/_8$ of an inch long. Distance has caused it to shrink optically from 700 feet or more to a mere fraction of an inch.

Now, if you can imagine the precision necessary in a range finder to drop bombs on the funnels and gun turrets of that ship, you have some idea of the precision that is built into the center scope we are about to describe.

But first, let us establish the fact that practically all mechanical devices are put together with holes—holes that must be punched, stamped, drilled or bored on a lathe. The strength and ultimate performance of the finished part, whether it is used in the construction of a bridge, a battleship or an airplane, depends greatly upon the exact positioning of these holes so that pins, bolts, rivets, screws and other fastening means are accurately placed and not subject to undue stresses and strains in use. In multiple production where a great many identical parts are to be made and assembled, it is doubly essential that each hole be accurately placed so that assemblies will fit.

That is why engineers and draftsmen devote so much time and effort to preparing elaborate plans. Every detail of a device, and every possibility of failure is studied and evaluated in advance. Minute details of manufacture and assembly are carefully considered and incorporated in the final drawings before blueprints are made. Tolerances are established to allow for mechanical inaccuracies in manufacture and to meet human deficiencies in translating the drawings and plans into cold steel. Tolerances may be ±1/1000 in. or, in some instances, ±10/1000 in., or less.

When drawings are transferred from paper to metal for mechanical operations, scratch lines are used instead of the pencil lines that appear on the blueprint. These scratch lines are made with fine scribing tools and are seldom more than 1 or 2 thousandths of an inch wide. Where a hole is to be drilled or bored, the lines appear at right angles as minute cross marks and the hole must be drilled at the exact point where the lines cross. In aircraft work, for the sake of greater accuracy, drawings are frequently transferred to steel or aluminum by photography. When such methods are employed, the layout lines are exceptionally fine.

The accurate positioning of these many holes so that not one of them will be out of place more than the allowed tolerance, requires mechanical assistance of one sort or another. The human eye and the human hand are not well enough coordinated by nature to do it alone. Consequently, to facilitate this work, the center scope was designed. It is a simple device on the order of a microscope which quickly slips into a spindle collet or drill chuck (Figs. 2 and 3) and magnifies the layout lines so that a workman can quickly set his machine in the right position to drill or bore.

Looking through the lens of the center scope, the tiny layout lines on the block of metal look like a fine-lane highway. About an inch from the eye of this instrument is a "stop" lens on which is engraved a dotted line, 3/10,000 in. in width. Continuing the simile this dotted line appears to be about the size of a string of automobiles. It is a simple matter, then, to place the automobiles in the center of the highway. Revolving the center scope in the chuck will reveal any inaccuracies of position and they can be corrected by moving the work in relation to the machine spindle. And

* Chairman, Advisory Board, Plastics Industries Technical Institute.

after such an adjustment is made, the machine is in the proper position to drill accurately.

The field of the center scope is in actuality about the size of the lead in a pencil but it appears to be as large as the end of a No. 2 tomato can. Therefore, there is plenty of field and plenty of light to center the drill. The field of vision is tiny to insure precision. It is not possible with this instrument to move the eye to the right or left enough to distort the picture. The eye simply moves out of the field and nothing can be seen.

The center scope has been a godsend to manufacturers who have had to train green help to make tools and dies. Old-time machinists with years of experience knew the requirements of accuracy and seldom failed to achieve reasonable precision in their work. Although various devices were used, long training in precision work made the workers careful and painstaking. Not so with new help. But with the center scope these inexperienced men can attain with a minimum of training the same precision as old-time machinists.

Stanley Griffin, inventor of the center scope, began working on the device during the last war when he was trying to turn out toolmakers for the Savage Arms Co., in 48 days. At that time, holes were usually centered and started with a fine prick-punch. A high-powered magnifying glass was used to help position these prick-punches somewhere near the spot where the cross lines met. Often holes were out of line—trouble the powerful magnifying glasses did not correct. The higher the magnification, the greater the eyestrain, and the poorer the work. Operators were bothered by parallax and couldn't spot the hole.

In designing the center scope, Mr. Griffin overcame this difficulty by placing the lens and prism in a fixed position where no adjustment is ever necessary. In this universal position it fits all eyes, old or young, whether glasses are worn or not. He placed the dotted line on the "stop" lens so that the eye does not "pump" back and forth between the bottom of the field, where the work is located, and the focal point. Through the use of this device an inexperienced man with 20 minutes' instruction can obtain a greater degree of precision in the spacing of holes and their location than any toolmaker, regardless of the length of time he has been at the bench, can even hope to approximate without the aid of the center scope.

The device is in the machine only a short time. The worker looks through the lens, makes the adjustment one way, turns the device to a right angle position, locates the second line and takes the instrument out. Practically absolute precision is achieved in 30 to 40 seconds.

Until about a year ago the center scope was made of aluminum alloy which, after years of development, appeared to be the best medium for the bodies of the instruments. When the government said, "No more aluminum under any conditions," the manufacturers began looking into plastics which seemed the next best bet. They discovered two remarkable things. By using plastics, they not only achieved a lighter-weight instrument with a permanent finish which does not chip off, but they solved an extremely critical manpower problem in finishing and assembly.

The center scope, made in aluminum, required 5 parts—2 aluminum castings, 1 aluminum or brass tube, a brass tunnel and brass objective which holds the objective lens near the work. Aluminum castings were delivered rough. Machining and finishing operations involved labor costs of 7 cents to $2.00 for each part. Machinists with long training and skill were needed to achieve the precision necessary in machining and assembling the device for accurate work. Then, the device had to be polished, prime coated, enameled and then baked.

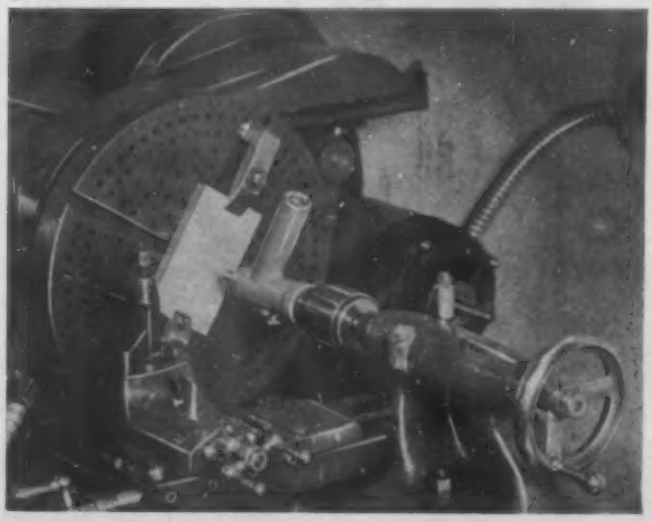
"In plastics," says Mr. Griffin, "the finishing operations are eliminated—there just aren't any. For 10 cents per instrument we can drill and tap all the necessary holes, of which there are 5 for adjustment. The parts fit so nicely we have done away with the set-screw we always used for holding the eyepiece in the body. The four plastics parts which comprise this unit cost three times as much, not to mention the cost of the die, but the finishing operations costs have been reduced about 90 percent."

When metal was used, each device required approximately 6 man-hours to finish and assemble. And these man-hours were for skilled machinists who were hard to get. Assembly and drilling of the plastics device requires about one-tenth of the time previously consumed and the work is done by girls.

The changeover to plastics was no simple matter according to the molder who engineered and built the mold. The device is injection molded in 4 pieces with extremely close tolerances and rather thick walls. The eye piece and end piece with a metal shaft insert are made to a press fit. That means that when these parts are pressed (*Please turn to page 194*)

2—The center scope is fastened in the tail stock jig of a lathe, remaining stationary while the work revolves. 3—Slipped into position in the spindle collet of a vertical boring mill, the instrument magnifies layout lines on steel "blueprints," enabling the operator to set his machine precisely

2 PHOTOS 2 AND 3, COURTESY CENTER SCOPE PRODUCTS, INC.



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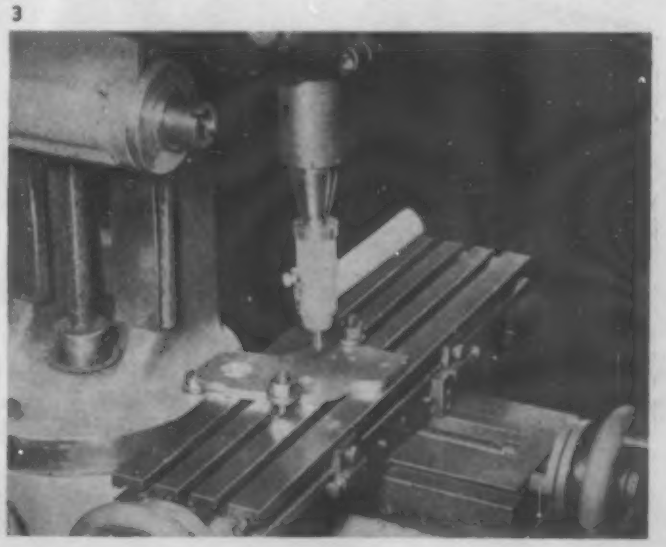
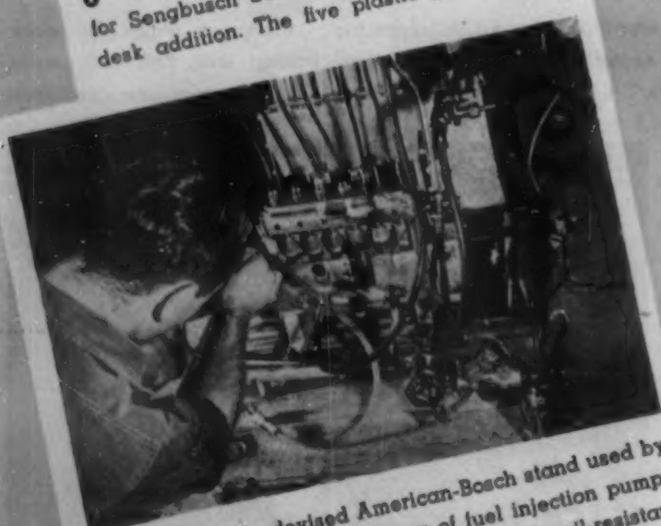


Plastics

1 Among the plastic parts comprising the R-6 war helicopter cabin are Plastiply fuselage panels produced by Haskelite Mfg. Corp. By molding these panels to shape during the curing cycle, "spring-back" is eliminated and a satisfactory fit assured

2 The advantages of clear plastics in working models of intricate machines are shown in this Lucite reproduction of a journal bearing, machined to close tolerances, for visualization of working parts

3 These self-closing inkstands with top and interior fittings injection molded of Tenite by Kampa Mfg. Co. for Sengbusch Self-closing Inkstand Co., are a welcome desk addition. The five plastic parts form a single unit



4 A specially devised American-Bosch stand used by Durham Co. for the testing of fuel injection pumps for diesel engines, employs transparent oil-resistant Resistoflex compar tubing for all fuel connections

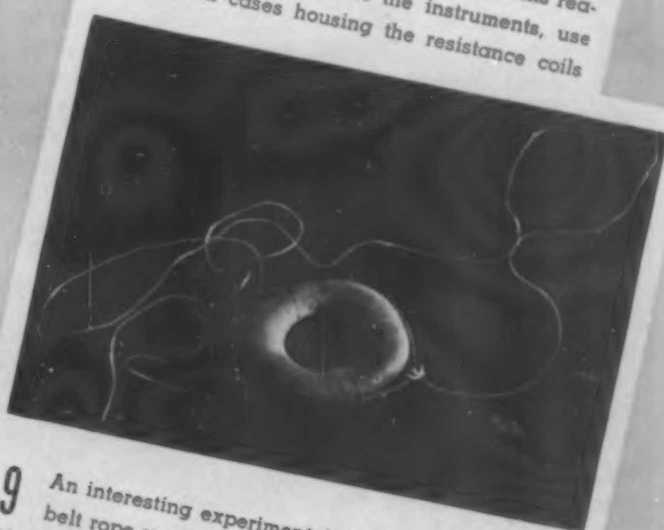
5 Cool water is nectar to a thirsty GI on a desert or in a jungle. To assure its presence, self-cooling water bags of Army duck treated with Rhoplex WC-9, in conjunction with Primal C, were developed after research by J. Bancroft and Sons Co., Jeffersonville Quartermaster Depot and Office of Quartermaster General

6 One of the greatest menaces to health in summer weather is the common or garden variety of fly. Developed as a highly-accurate preventive, these Ace fly traps, injection molded of Tenite II by Precision Molded Plastics, Inc., can be attached to any Mason jar

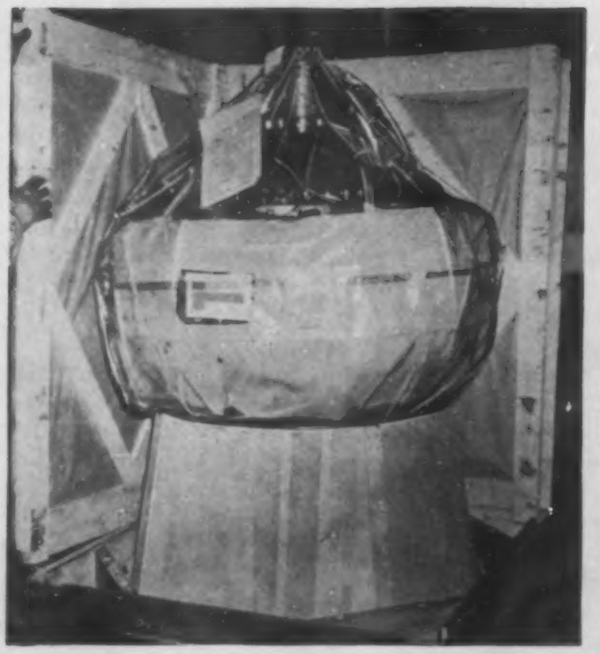
7 A bright note is added to kitchen equipment with these lightweight Durabrite dustpans of Tenite II or Ethocel, molded in single-cavity dies in a variety of colors by Plastic Die and Tool Corp.

in Review

8 In potentiometers for measuring electromotive forces involuntary reactions must be minimized. For this reason, DeJur-Amsco Corp., makers of the instruments, use Durez for the molded cases housing the resistance coils

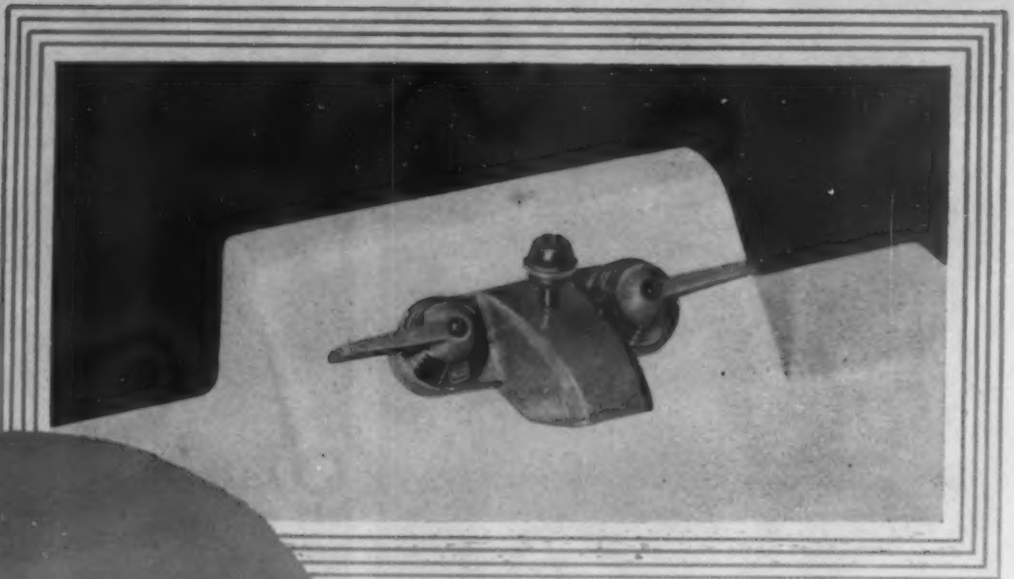


9 An interesting experimental application is this life-belt rope woven of polyethylene monofilaments. Its high strength enables it to resist the most violent ravages of a stormy sea while bearing the weight of the rescued

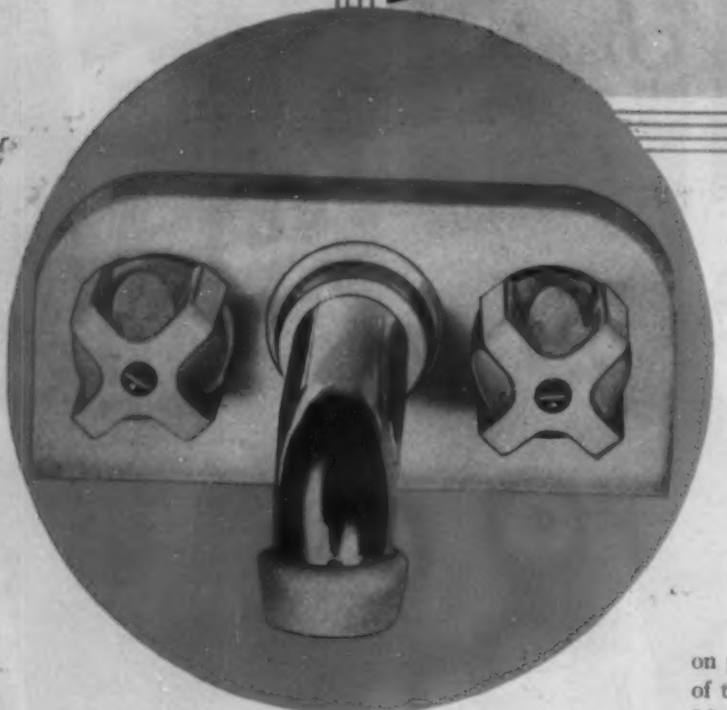


10 So that aircraft motors can be shipped to remote fighting zones assembled for immediate use, Pratt and Whitney now pack their motors in a plastic envelope and bolt the motor to a plywood cone, to brace it. Veneers for the plywood shipping mount, manufactured by Superior Industries, are bonded with Uformite 500

Because of their easy-to-clean and insulating qualities, plastics are well suited for use in plumbing fixtures. The tentative designs shown here suggest one possible type of application



PHOTOS, COURTESY CRANE CO.



An eye to the future

OF the 1,540,000[1] dwellings that statistics tell us will be built in the first few years of peace, many will be purchased by experienced home owners, and many more by young couples who have had the long war years in which to ponder the advantages and disadvantages of different styles of architecture and to learn the fine points of construction and household fittings. This group will not be rushed into signing the final papers until it is certain that the homes in which they are investing their future are durable and practical as well as beautiful.

To the plastics industry this means that these men and women are even now taking stock of the performance of plastics as applied to household fittings. And they are seeking the answer to the question of how much of the speculation regarding the use of plastics in the postwar is true, and how much pure fantasy. In this answer will lie the final acceptance or rejection of plastics for these uses.

In the field of plumbing fixtures, for example, plastics have been suggested for piping, for bathtubs, for shower heads, for faucets, for kitchen sinks. The separation of fact from fancy has been well outlined in a recent statement by Henry Dreyfuss, industrial designer, who has done extensive research on possible applications of plastics as replacement for many of the more common uses of both metal and wood. In part Mr. Dreyfuss said:

"It seems long ago that odd concoctions (later to be included under the general term of plastics) were being used only for industrial purposes. Electrical engineers had discovered the excellent insulating qualities of a built-up substance made of shellac—but it was years later before the element of beauty in synthetics was recognized by the designer and used in consumer products. Today it would be difficult to walk into a home or place of business and not find plastics incorporated in dozens of products in everyday civilian use.

"Danger, however, lurks around the corner. Some manufacturers, anxious to give products the best in utility and material, have often accepted plastics before determining whether or not a plastic is the best material for a particular use. Plastic cover plates on a Diesel engine would perhaps do the job but they wouldn't do it any better and perhaps not as well as ones made of steel. On the other hand, plastics release knobs for these cover plates do the job better than the metal ones formerly in use.

"In the case of lavatories, bathtubs, kitchen sinks, and water closets, the use of plastics for the trim of these fixtures should be encouraged. The easy-to-clean and insulating qualities of these materials contribute greatly to the utility of the product. The field of plumbing fixtures—or trim, to use the technical term—offers a number of interesting possibilities. Take the tentative (*Please turn to page 202*)

[1] National Chamber's Consumer and Industry Survey of Postwar Needs, Chamber of Commerce of the United States.

Transparent training aids

In order to facilitate the training of ground crews in the intricacies of different systems in an airplane, the Army training schools employ models of these units, which are housed in transparent acrylic resin so that the inner workings can be seen at a glance

by RICHARD H. HOLMES*

AS thousands upon thousands of warplanes rolled from the production line, it became apparent to the United States Army Air Corps that considerable numbers of technicians and mechanics would be required to maintain these planes in proper order. Rigid combat requirements in all theaters demanded this. Therefore, to train these men quickly and thoroughly, Army Training Schools were established near the plants of plane manufacturers in all parts of the country. Mock-up planes were erected in these schools to indicate where control cables, electrical and hydraulic lines were run. Cutaways were made on actual parts to show how they performed. Countless photographs, diagrams and moving pictures were shown to illustrate what an airplane and its component parts do in flight.

At the Army Training School located at the Santa Monica plant of Douglas Aircraft Co., Inc., ingenious devices have been set up to present more clearly the functions of different systems in an airplane. As an example, all the intricate valve parts, springs, packings and pistons of every hydraulic unit in the A-20 and C-54 airplane have been encased in acrylic. By arranging these units on a panel and making corresponding line-connections between them, an internal picture of the whole assembly can be seen at a glance. For the young men assigned to these schools, there is no better way of getting a thorough training in the intricacies of the hydraulic system than to be able to observe the interior of the units.

*Research design engineer, Douglas Aircraft Co., Inc.

It was no easy matter to work out this method of teaching. It started about 10 months ago when the U. S. Army Air Corps gave the Douglas Research Design Group an order to convert all the A-20 and C-54 airplane hydraulic units into visual objects (Fig. 1). The actual hydraulic assemblies in these airplanes operate under terrific fluid pressure in order that the units may be compact and light in weight. The C-54 main system, for example, functions at 3000 p.s.i.—a pressure that makes necessary the use of special metal alloys in the construction of the system.

Acrylics, however, do not have the strength characteristics of these alloys. Therefore, in making these transparent instructional models, engineers decided to have them operate at a safe pressure of 300 p.s.i. and specified a factor of safety of 2. Even with this relatively low pressure the walls of the various housings could not be made as thin as the actual part. Tolerances were made more lenient for several reasons: 1) coefficients of expansion of dural and acrylic are different, and 2) lower pressures were used.

In machining the housings great care had to be exercised to make sure that the cutting tool, which tends to absorb the heat, did not become so hot that it scored the plastic. A comparatively slower cutting speed than that used on high alloy aluminum or steel was necessary, coupled with a lubricant and coolant which is composed of liquid soap and water. After machining it was necessary to polish out the infinitesimal scratches on the surface by first applying fine

ALL PHOTOS, COURTESY DOUGLAS AIRCRAFT CO., INC.

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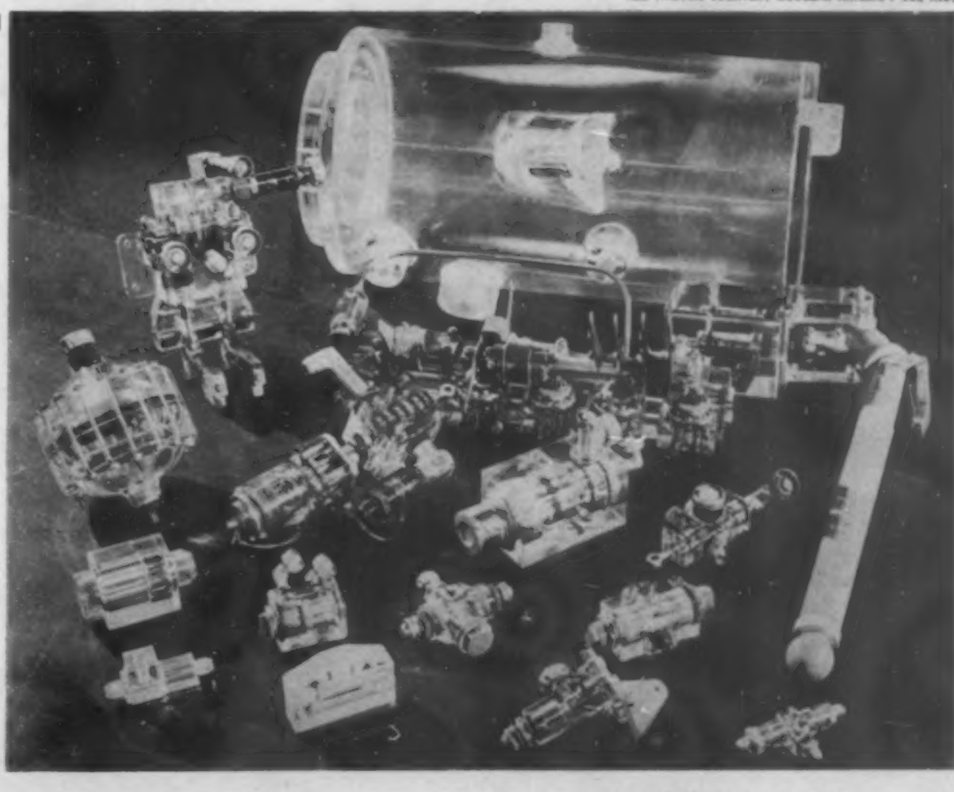
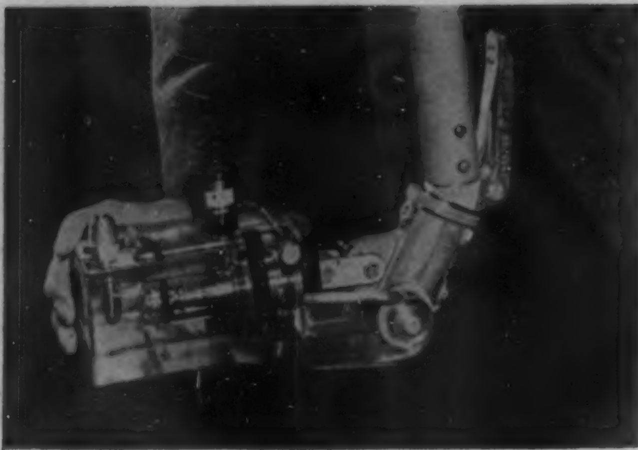


1—This group of transparent models is typical of the hydraulic units of the A-20 and C-52 airplanes that were transformed into visual objects about 10 months ago to speed the training program



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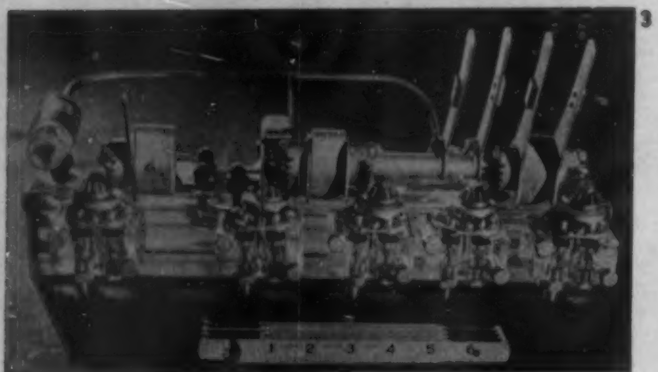
emory cloth and then using rouge and a buffer of the type employed on optical lenses. The result was a beautiful clear and transparent body. All sharp edges and corners were, of course, radiused and smoothed to prevent chipping and the danger of cracking. Wherever it was impractical to machine a unit from a solid round or square bar—as in the case of a tab, fork or a bracket—these parts were produced separately and then cemented to the main body with ethylene dichloride. This solution dissolves the methyl methacrylate locally and gives a satisfactory bond to low-stressed parts without impairing the visual qualities of the model.

In making the hydraulic reservoir as shown in the background of Fig. 1, and in Fig. 4, the acrylic sheet was heated to a temperature of approximately 250° F. by placing it in an oven with subsequent careful application of a blow torch. Then the sheet was formed and the seams cemented with ethylene dichloride. All springs in these training aids had to be redesigned and reduced in compressive strength to permit the units to function under the low pressures. In some cases, ball seats, parts and pistons were also redesigned to provide proper operation of the unit. Accumulators are used only in emergency in the event of a hydraulic power failure in major operating parts such as steering, braking and landing gear systems. The accumulator, which is spherical in shape, is separated by a special rubber diaphragm. One chamber is partially filled with oil; the other with highly compressed air. When the fluid is required, a valve is opened and the oil forced out at high pressure.



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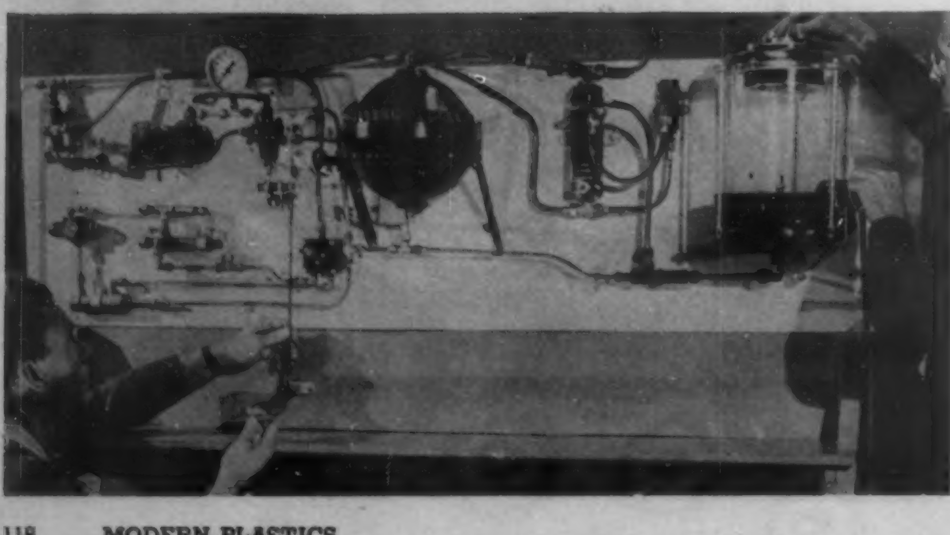
Emergency high-pressure hand pumps—used to release such parts as wing and cowl flaps—must have a debooster to reduce a high pressure to one that can be easily controlled. This operation is performed by springs and pistons that control the rate of flow and the volume of the fluid, which is an essential element in braking or steering applications. In order to see the hydraulic fluid as it flows through the lines, acrylic tubes are used. Further, mineral fluid of the same red color and with the identical viscosity rating as the fluid used by the airplane when in operation is employed in the training school.

4

Through the ingenuity of engineers and shop men, transparent plastics have found another field wherein they can aid in the war effort. Little wonder that Uncle Sam not only has the best airplanes and pilots but also the best trained men for the highly essential work of keeping them in flying condition.

Credits—Material: Lucite and Plexiglas. Models by Douglas Aircraft Co., Inc.



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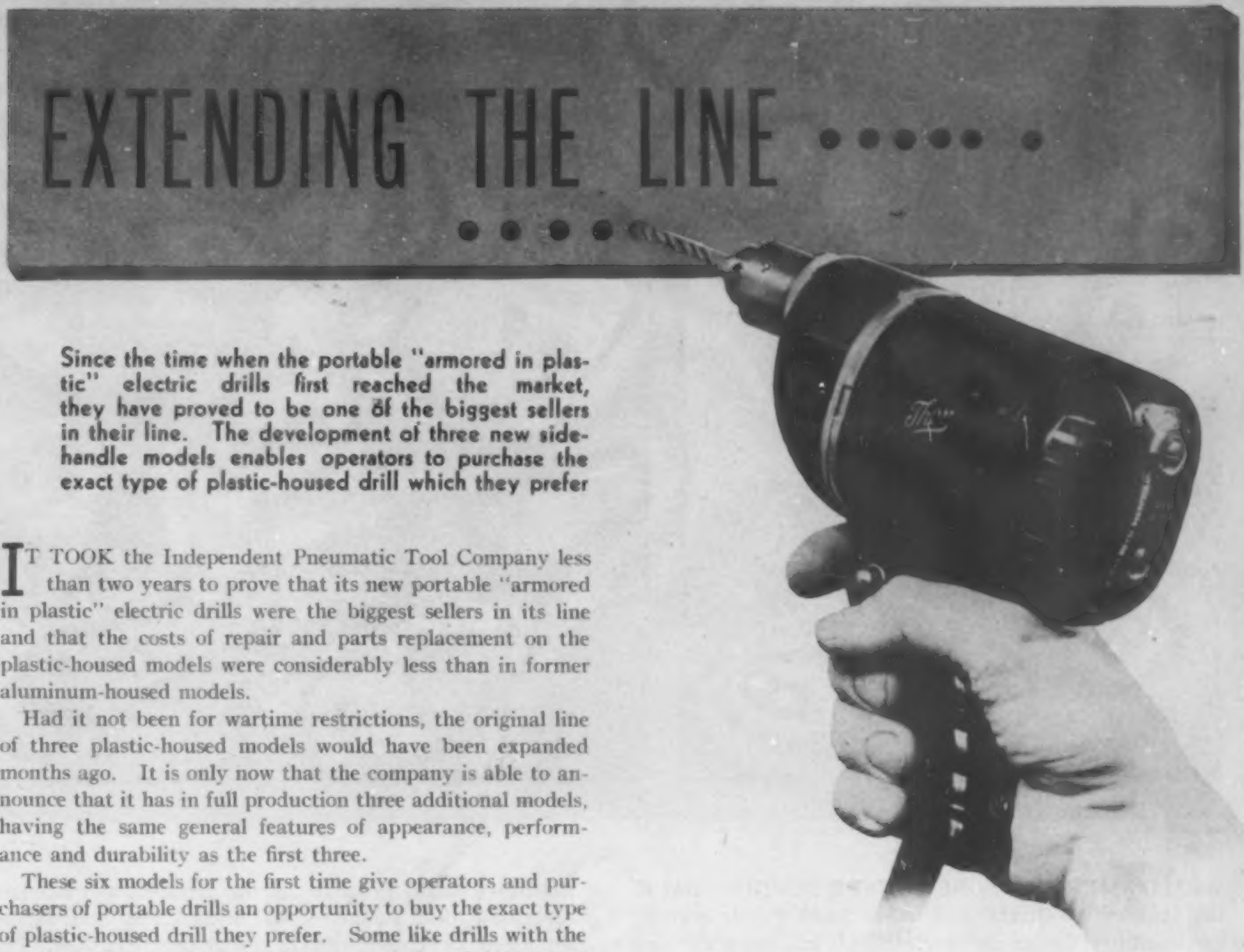
***2**—The acrylic housing of this cockpit hydraulic hand pump gives a clear view of the inner workings of the unit. **3**—A transparent housing was also developed for the cowl flap and carburetor air filter manifold valve assembly. **4**—Here a hydraulic reservoir is compared with the model. **5**—This hydraulic mock-up shows the operation of the system*



Since the time when the portable "armored in plastic" electric drills first reached the market, they have proved to be one of the biggest sellers in their line. The development of three new side-handle models enables operators to purchase the exact type of plastic-housed drill which they prefer

IT TOOK the Independent Pneumatic Tool Company less than two years to prove that its new portable "armored in plastic" electric drills were the biggest sellers in its line and that the costs of repair and parts replacement on the plastic-housed models were considerably less than in former aluminum-housed models.

Had it not been for wartime restrictions, the original line of three plastic-housed models would have been expanded months ago. It is only now that the company is able to announce that it has in full production three additional models, having the same general features of appearance, performance and durability as the first three.

These six models for the first time give operators and purchasers of portable drills an opportunity to buy the exact type of plastic-housed drill they prefer. Some like drills with the handle at the rear of the drill body—the design of the original models. Others like drills with the handle at the side (or center); this is the design of the models just introduced. All bear the trademark "Thor."

The new side-handle drills are identical except for the gearing of the motor. Model U14KS operates at 2500 r.p.m., an ideal general-purpose speed with a $^1/_4$-in. drilling capacity. The Model U12KS has a speed of 3500 r.p.m. It is most useful for general-purpose work with a $^3/_{16}$-in. drill, although it, too, has a drilling capacity of $^1/_4$-inch. The third model, the U13KS, has a free speed of 5000 r.p.m. and is best adapted to $^1/_4$- and $^3/_{16}$-in. drilling work on aluminum and other light metals. All of the models will take drills down to $^1/_{16}$ in.—even down to $^1/_{32}$ in., as is the case in some aircraft plants.

Construction features of the first Thor "armored in plastic" drills, and the successful merchandising campaign introducing these products to the trade and describing the advantages of the plastic housing are well known in many industries.[1, 2] Moreover, these first drills now have behind them a long period of trade acceptance and proved performance. As a result, Thor officials predict that the new side-handle models will take their place at once as leading sellers in the line. Retail price is $38.00 for all three speeds.

Injection-molded of a variation of cellulose acetate butyrate, the plastic housings of these models are designed and built for heavy-production service. They are approximately 20 percent lighter than their aluminum counterparts, the weight of all three being 3 lb. 13 oz., the same as the

1—Developed for those who prefer side-handle drills, this electric portable drill is one of the three new models added to the plastic-housed line of drills

plastic-housed models with the handle at the rear. The length of the side-handle models, however, is only 7$^9/_{16}$ in., compared to 8$^3/_{16}$ in. for the rear-handle types.

All internal operating parts are supported in a sturdy metal skeleton frame which forms an independent, self-contained unit. Plastic parts (Fig. 2) consist of a field case and side handle (*A*), in one piece; the gear-case cover (*B*), and the field-case cover (*C*). In addition, there is a trigger-type switch (*D*), molded at the same time as the gear-case cover, and a handle cover (*E*).

In the handle section are located a two-pole neoprene-sealed momentary switch, the switch trigger which is metal lined at its point of contact with the switch operating mechanism, and the lock plunger. This lock plunger, pressed inward while the trigger is depressed, latches the switch in the "on" position until released by a slight pressure against the trigger. The cable that extends through the handle is readily serviced by removal of the handle end cover, the inside of which accommodates the cable clamp. A heavy rubber protection sleeve prevents sharp bending at the point where the cable enters the handle.

Design of the new drills is such that no external lubricating fittings are used. However, a (*Please turn to page 202*)

[1] "A handful of power," MODERN PLASTICS *20*, 55, 132–134 (July 1943).
[2] "A hand drill goes to market," MODERN PLASTICS *22*, 104–106 (Sept. 1944).

PLASTICS


1

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WHILE AMERICAN FORCES WERE TURNING BACK the Japanese at Guadalcanal, other South Pacific enemies combined to endanger our jungle fighters and harass the men of the United States Signal Corps. Field telephones mysteriously went dead; binoculars clouded; radios sputtered and failed. Word soon came back to headquarters in the United States that various detrimental effects such as humidity high temperatures and fungi combined to soak, warp and completely destroy or at least seriously impair the ultimate efficiency of Signal Corps field equipment. The effect of these conditions on laminated terminal strips and boards, switchboard panels, etc., was a loss of insulating properties, creation of leakage paths that resulted in flashovers and a gradual destruction of the lamination. These same parts of molded plastics, especially the machined, sawed or ground edges and surfaces, acted to support the growth of fungi which again caused shorts and flashovers. Other materials fared no better when unprotected against the action of 18,000 different species of fungi in that zone of excessive heat, constant humidity of 90 percent or above, and a rainfall as great as 400 inches a year. Such conditions prompted the Signal Corps to request remedial action, and thus began the development of a new protective covering (Figs. 1 and 2).

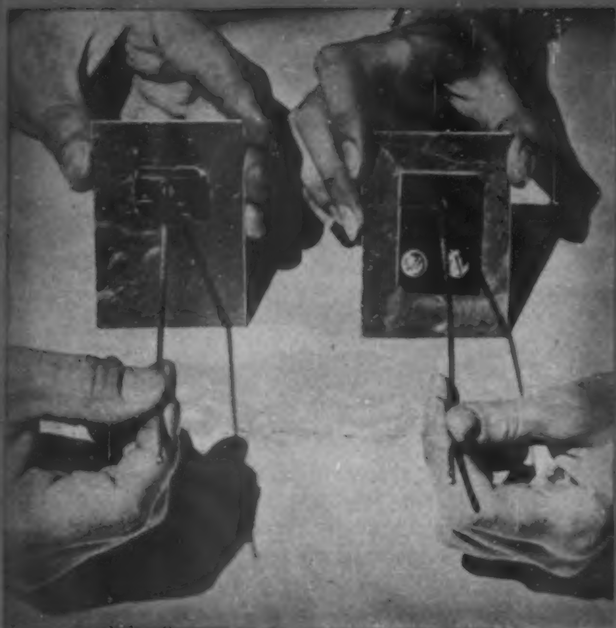
The first equipment which was treated with the new finishes was made by a Middle Western manufacturing company. There, in an enclosure called the "Bug House," the air contaminated by fungi was maintained at a temperature between 34 and 45° C. with a 90 percent relative humidity. Coated equipment was tested under simulated tropical conditions and the manufacturers checked against their own tests by flying coated equipment to a South Pacific area to test it during actual field performance in order to determine the fungus- and moisture-resistant properties of the varnishes and lacquers. Meanwhile, dead equipment was dried out by heat, sanded and wiped, and coated with the new protective lacquer. This treatment restored to use much of the equipment already damaged and kept communications open.

During this critical period, the Signal Corps coined the term "Tropicalization" to identify the process of immunizing equipment against moisture and fungus growth. Later when the Signal Corps worked out Specification #71-2202-A to minimum standards for protective coatings, "Tropicalization" was officially defined as "the treatment of equipment with a protective, fungicidal, moisture-resistant coating, and/or the redesign of components or substitution of materials to reduce or eliminate the effects of moisture and fungus on the operation of the equipment."

As required by the Signal Corps specification for these coatings, the process of immunization required certain minimum standards. The accepted film must have a dielectric strength at room temperature of not less than 500 volts per mil at 60 cycles, and it must be capable of withstanding thermal shock, bending tests and a 50-hr. immersion in a 5 percent salt solution at a temperature of 77° F. or over, without pitting, blistering or discoloring. It must also be nontoxic to humans.

During the period of testing conducted at home and in the field, manufacturers of industrial finishes developed coatings to meet all requirements of these specifications. Lacquers and varnishes with pentachlorophenol and phenyl mercuric salicylate as the fungicides were produced for application on components and hookup wire prior to assembly and for over-all treatment after assembly. For use on laminated or molded phenolic plastics including insulators, terminal and junction

PRODUCTS*



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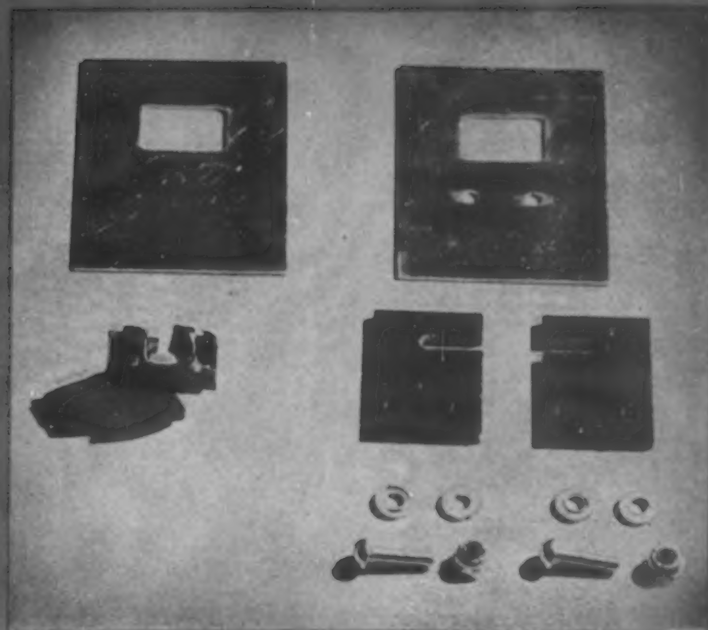

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blocks and the fixed windings of motors, generators and dynamotors, a baking varnish with a pronounced adhesive quality containing phenyl mercuric salicylate as the fungicide was developed. In addition to preventing the formation of any fungus growth on vital parts, these finishes produce an area of inhibition around each coated part in which fungus will not grow.

The protection of communications equipment by Tropicalization has widened its areas of use. Moisture and fungi are not peculiar to the tropics. They are encountered in all areas in which Signal Corps equipment is used. Since it has been found that equipment so treated stands up better in any climate, equipment for all theatres of war is now being protected by Tropicalization.

Credits—Material: Durad fungus resistant coating. Developed by Maas and Waldstein Co. in cooperation with research staffs at Camp Evans Signal Laboratory and Fort Monmouth Signal Laboratory, units of Signal Corps Ground Signal Agency.

THE COMPLEXITY OF KNOBS AND INDICATORS on the pilot control board of a plane give only a slight idea of the multitudinous series of cables that connect these knobs with the parts of the plane which they control. Threaded under the floorboards and along the sidewalls, these cables extend to every minute part of the ship's equipment which must respond on the instant to the quick turn of the indicator by the pilot.

To protect these cables against abrasion where they pass from the knob through the panel board, fairleads are installed in slots cut in the panel for this purpose. Originally these fairleads consisted of two pieces of laminated phenolic held together by eight washers, nuts and bolts which had to be assembled by means of a wrench and a screw driver (right, Figs. 3 and 4). Such leads were subject to frictional wear and had to be replaced with comparative frequency.

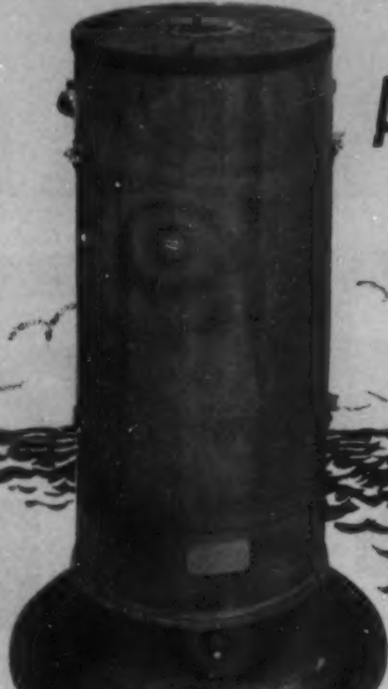
More recent developments have produced a snap lead weighing but 5 grams, composed of two pieces of plastic held together by two tiny rubber strips (left, Figs. 3 and 4). The strips which serve the dual purpose of holding the companion plastic pieces together and providing an elastical grip as the lead is snapped into panel slots, are held in place at four opposite points by means of an exclusive process of cement-binding.

After the cable and pulley have been put through the panel hole, the lead is slipped over the cable by means of a slot formed while the plastic lead is relaxed. The lead is then pushed into the panel hole, and snapped into place with the thumb. Two tiny ridges—at the top and bottom of the lead—grip the edges of the panel slots. Tension set up by the rubber strips sets and holds the leads in place. When pressed into position, the two plastic pieces form a single unit containing a hole of either three-sixteenths or one-quarter inch in diameter through which the flexible metal leads or cables pass from various controls of the plane to the pilot's cabin. An additional advantage of these leads is a belled surface at the mouth of each lead hole which minimizes the possibility of rubbing and resulting frictional wear as the cables move backward and forward.

Credits—Cycle-Weld process of cement-binding. Fairlead developed by Cycle-Weld Div., Chrysler Corp. Manufactured by Chrysler Motors of California.

* Reg. U. S. Patent Office.

A PLYWOOD BINNACLE STAND



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To those who have never been "to sea"—and perhaps even to many who have—a binnacle stand doesn't mean much; but to those who guide the ship it means everything. If power is the heart of a ship, then the compass might well be called its mind—and the binnacle stand houses the compass and lights for illuminating it. Originally it was a rather simple affair, but today it has become an elaborate and intricate piece of equipment.

When the Navy decided upon a change-over from standard-type binnacle stands for PT boats to resin-bonded plywood stands, the only feasible production method seemed to be by the low-pressure bag molding method. However, the engineers of the Red Lion Cabinet Co. were not content with this slow production method. They soon developed a new type of equipment which is unique for molding this material. In addition, production was considerably advanced.

The location of a binnacle on a ship is determined only after a careful and detailed analysis of such factors as the structural materials used on the ship, its cargo, and all other elements which might have a bearing on the functioning of the delicate compass which the binnacle holds. This stand is usually about waist high, fitted with two cast-iron spheres—one on each side of the housing—which help to correct deviation. It is also equipped to receive permanent magnets and soft iron pieces so placed as to help offset other inaccuracies. These small fittings are literally tailor-placed on each individual ship. That is why there are so many small holes in the interior framework which can be seen in Fig. 2 where the door has been removed from the stand. All brass fittings on the stands are of special iron-free brass.

The exterior of the new-type binnacle, as produced at this company, is two-ply canvas impregnated with phenolic resin. In the tubular section (Fig. 4) this canvas is bonded integrally to 9 plies of mahogany which have also been coated with a phenolic resin adhesive and form—under heat and pressure—a homogeneous unit which has great strength without great weight and is highly resistant to fire, grease, oils, salt water and atmospheric change.

The base (Fig. 3), referred to as the hat because its original formation is strikingly similar to that of a molded hat, is

ALL PHOTOS, COURTESY DUREZ PLASTICS AND CHEMICALS, INC.

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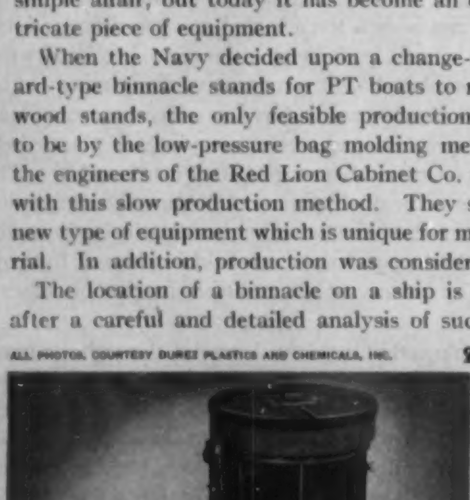

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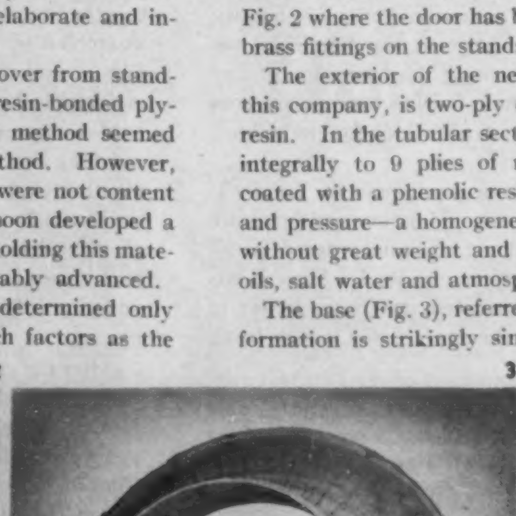

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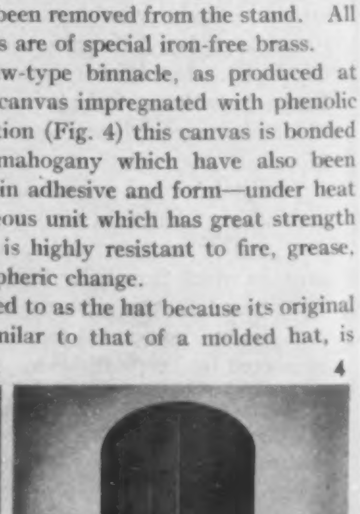

rather unusual in construction. It is made from die-cut sections of the phenolic-resin-impregnated canvas. The exterior half of the base is molded in steel molds under heat and pressure (at approximately 300° F. and 200 p.s.i.). This half (Fig. 5) is fitted over the outside of the laid-up tubular section and the whole unit placed in another heated mold where not only the bonding of the tube but the bonding of the exterior half of the base to the tube takes place. Specially designed molds and fittings make this possible.

Upon removal from this mold, the interior of the base of the tube is tapered. Another 15 plies of phenolic-resin-impregnated canvas are laid up on the inside of the base, and the entire unit again subjected to heat and pressure in another steel mold where all sections are bonded together to form a homogeneous unit. The junction of the interior half of the base with the tubular section forms a marking rim upon which the interior wood framework of the binnacle rests. This framework is also of mahogany. The uprights, circular top and crosspieces are of solid mahogany, whereas the arc segments are of 9-ply mahogany veneer which is bonded under heat and pressure with the phenolic resin adhesive. In the makeup of these segments, the even-numbered plies are coated on both sides with the resin prior to bonding. A complete piece about the size of the door of the binnacle is formed in a curved shape and later sawed to the proper dimensional size.

Each door is cut from the molded tube section with which it is to be used, and the base is drilled to specifications for fastening. After final assembly, the binnacle is given a coat of spar varnish to add to its already well protected exterior.

Credits—Material: Durez resins. Stand molded and assembled by Red Lion Cabinet Co.

1—Resin-bonded plywood binnacle stand for PT boats produced by specially developed equipment. 2—Stand with door removed to show holes drilled to counter-act magnet fittings. 3—Base or "hat" section of stand. 4—Lay-up of interior section of base. 5—Exterior half of base being molded in steel molds under heat and pressure. 6—Lay-up of plywood and canvas being prepared for bonding of cylinder. 7—Final molding of base assembly shown in Fig. 4. 8—Cylinder and hat sections in process of molding

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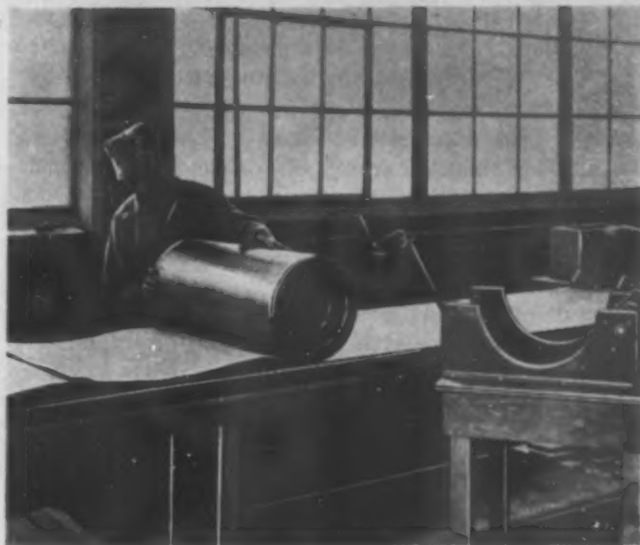

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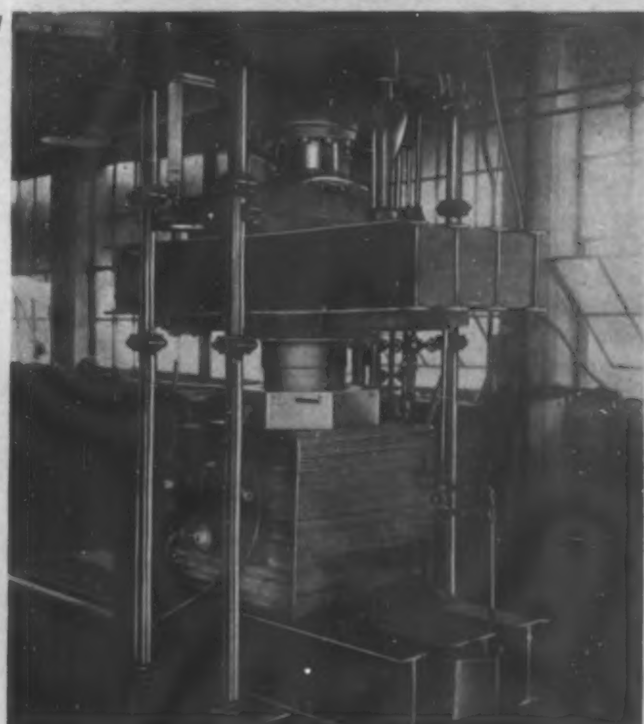

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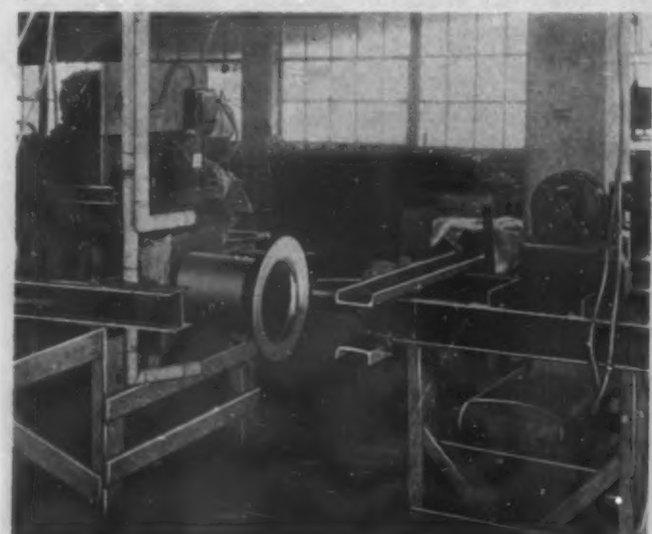


A forecast of raw material availability

by R. L. VAN BOSKIRK

THE plastics raw materials picture looks cloudy, confusing and none too good for civilian production during the next few months. A comparison of past and present monthly allocation reports gives a definite indication that the reports for the first quarter of 1945 will be considerably different from the reports that were issued in the first quarter of 1944. Materials such as benzol and cresol from which plastics compounds are made will continue tight—as they were last year—and there will be continuing stringency in such items as formaldehyde, acetic anhydride, plasticizers of nearly all types, and perhaps cotton linters and wood pulp.

In addition, nearly all producers have heavy backlogs, and practically all war orders, including those in acetate, are coming back again. And new military uses have been added. It is feared that in some cases civilian orders are interfering with military production, and there is little doubt that a crack-down will take place if such a situation continues to any appreciable extent.

We are more or less going "out on a limb" in attempting the following predictions. A sudden change in war conditions, either a great military defeat or victory, would completely invalidate this forecast since such a turn in events might make a considerable difference in the amount of material available for civilian uses. However, it is difficult to believe that there is much hope for relief in the chemicals supply line within the next 3 months regardless of military developments, and for many items the stringency may continue over a longer period of time—even if Germany should suddenly fold up and military demands decrease.

Cellulose acetate and butyrate molding powder

Military orders have continued to increase each month since last Fall. There have been recent increases in orders for such things as ammunition rollers, steering wheels, airplane control handles, communications parts, whistles, and for even the more prosaic items such as toothbrushes and soap boxes. The total monthly production of 5,500,000 lb. which had been coming steadily from the producers' plants for a couple of years is believed to have dropped off slightly during the past 2 or 3 months due to problems with manpower, plasticizer and other raw materials. It is a little difficult to understand last few months' allocation figures which show more than 4,500,000 lb. allocated for civilian uses when it is believed that more than 2,000,000 lb. are being applied toward military applications.

This figure does not mean that 4,500,000 lb. were shipped. It means that producers applied for authorization to ship this amount for civilian uses. Actually they did not receive sufficient quantities of raw material to produce 4,500,000 lb. of molding powder for civilian purposes, and the reason they did not receive enough was increased military demand plus raw material shortages such as exist in the cases of acetic anhydride and plasticizers.

Since civilian allocation of acetate is now left entirely in the hands of distributors under Paragraph (*f*) of Chemicals Order M-300, it is difficult to tell which civilian items will be most severely curtailed. Producers may vary in their distribution and send out their orders according to 1) past usage, 2) essentiality on a pattern similar to that which was used by WPB when they distributed civilian material and 3) in some cases, various reasons which the producer may have for supplying certain customers first.

Plastics Branch officials have been emphatic on insisting that they will *not* take back responsibility for determining relative essentiality on acetate used for civilian purposes. Their attitude is that any irreplaceable item will be cared for without direction from WPB. Take pencil ferrules as an example. They may be essential as such but they are *not* so highly essential that there is no other way of performing the function by another means or with another material. The fact that brass or steel or any other material may be closed off is no claim to the use of plastics as there is a "bottom of the barrel" to chemicals as well. Should the usage be so highly essential to the civilian economy and plastics are not available, then the only recourse is an appeal for the original material. Furthermore, officials assert they will no longer allocate material to keep a man in business when he is producing a non-essential item. Such problems will have to be solved by the industry members themselves.

There are various ways of arriving at this situation. For example, Judge Byrnes announced that it may be advisable for the War Manpower Commission to have power to go into a plant making civilian goods and decide how many workers they should have. If they have too many, some of them might be channeled into war plants. That is a drastic measure, but not an impossible one. A high WPB official recently stated that approximately 45,000 workers were making costume jewelry in New England and that he couldn't understand why they were so employed when children's underwear was practically impossible to obtain. That sort of thinking in high government office is worth watching. In view of all this background, it seems only logical that the amount of cellulose acetate available for civilian use will steadily decline during each month of the quarter.

Cellulose acetate butyrate is already well along the way to total use for military applications. Even today it is reported that there is not enough of this plastic for such important civilian applications as telephone housings, communications and plumbing.

Cellulose acetate sheeting

First grade sheeting is extremely tight because producers require phthalate plasticizer for its manufacture. Furthermore, military requirements are continuing high. It has been generally unnoted in the recent allocations that various amounts under Paragraph (*f*) were designated for pass covers shop travelers and blueprint holders used in war plants. It is not known whether any of this was delivered. The allocation was merely an authorization to the supplier to deliver it if he had enough material and could make it up without using phthalate plasticizer. A quantity of reject and scrap material has been allowed for end uses with essentiality below that set for first grade material. It is not expected that the sheet situation will change materially one way or another in the next 2 or 3 months. *(Please turn to page 196)*

PLASTICS*

Engineering Section

F. B. STANLEY, Editor

"Hy-speed" plunger molding

SOME time ago a committee was formed to investigate and develop a new system of fast molding of thermosetting materials. After many meetings, during which the ideas of the members were pooled, the committee—made up of two men each from the Plastics Division of Monsanto Chemical Co., Radio Division of Westinghouse Electric & Mfg. Co., and Baldwin Southwark Division of Baldwin Locomotive Works, and one man from the Hemco Plastics Division of Bryant Electric Co.—evolved a machine which will successfully injection mold thermosetting material at a very fast rate of speed.

Throughout the development of this equipment, the thought was always kept in mind that not only was a new piece of press equipment being developed, but also a new process. Paralleling in importance the development of the press equipment and of the design which all molds must follow in order to operate successfully by this process, was the inclusion of a radio-frequency generator to speed operations which, by preheating the preforms, makes possible the almost instantaneous injection of the plastic materials with minimum of pressure.

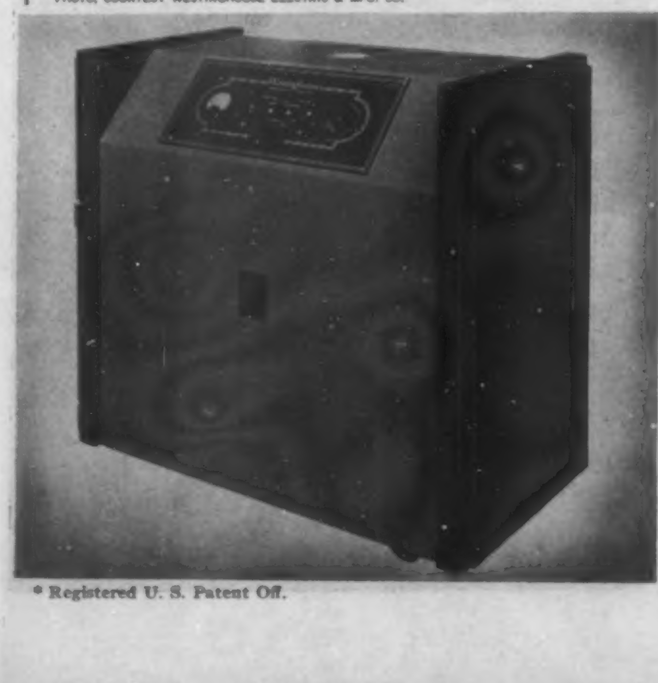
This generator operating at a frequency of 30 megacycles (30 million cycles) takes its power from a 220-volt single-phase 60-cycle power supply and is a completely self-contained unit. In addition to being provided with electrical interlocks which make it impossible to apply the radio-frequency voltage to the electrode unless the cover is completely closed, the cage furnishes electrical shielding for radio wave radiation. A push button on the inclined control panel permits the operator to start the preform heating cycle. An adjustable automatic process timer controls the duration of power application and, therefore, the final preform temperature. A two-position selector switch on this panel permits the control to be either completely manual or automatic as the operator may elect. Indicating lamps and a plate current meter give a visual indication of the generator's operations.

Changes in composition of the preforms will materially alter their electrical characteristics. Therefore, an adjustable load matching network, as it is termed by radio engineers, is provided to cover a wide range of preform characteristics. The adjustment of this network is simplified by the provision of a single external control knob. Thus an inexperienced operator by manipulation of this control knob and observation of the plate current meter, can readily make many changes which may be necessary due to a change in the composition of the preforms.

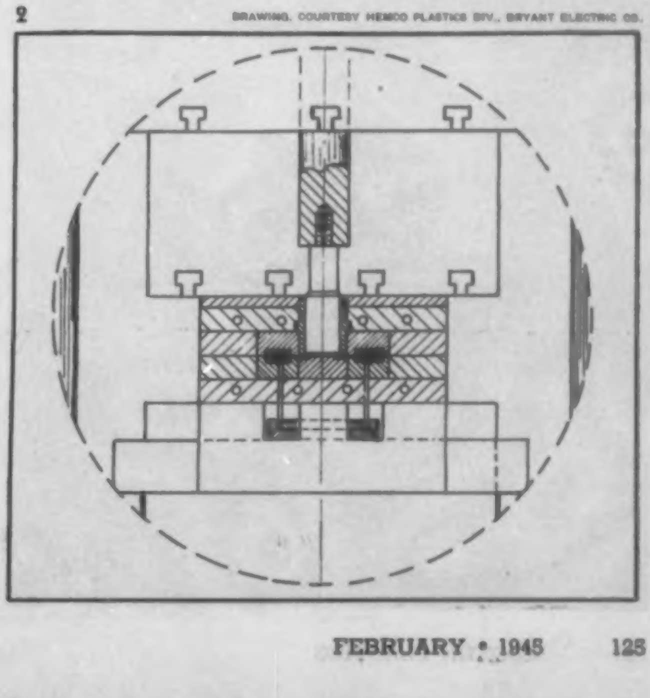
In order to further simplify this generator and adapt it for use in severe industrial service, a new air-cooled oscillator tube was designed which has a long service life when operating at these high frequencies. The necessary cooling air for this tube and other circuit elements is provided by a small self-contained blower. This electrical equipment is completely enclosed in a metal cabinet provided with access doors, safety interlocks and protective relays. *(Please turn to next page)*

1—This generator, operating at a frequency of 30 megacycles, is a completely self-contained unit. 2—Section view of a press shows general layout of mold with its integral pot and the transfer plunger

1 PHOTO, COURTESY WESTINGHOUSE ELECTRIC & MFG. CO.



2 DRAWING, COURTESY HEMCO PLASTICS DIV., BRYANT ELECTRIC CO.



* Registered U. S. Patent Off.

Fig. 2 shows a press with a 2-cavity blank mold already installed. The overhead plunger, or injection ram is so designed that preforms can be loaded into an open pot which is incorporated in the top plate of the mold. This pot or hole extends from the top to the bottom of this top plate. With the mold in the closed position, the preforms are loaded into the pot. Hydraulic pressure then causes the top ram to force the material out of the bottom of this pot, against a pressure pad in the lower half of the mold and then at right angles along the two or more runners, through the gates, into the cavities themselves. The plunger continues to force the material out of the pot until the cavities, runners, etc., are all completely filled with the partially polymerized plastic material.

This entire operation is carried out with high pressures in the pot and runners only, inasmuch as the very thin gates (approximately 0.015 in. in wall section) act as pressure-reducing valves between the runners and the cavities. The rapidity with which the plastic is forced through this small opening causes a marked rise in the temperature of the material—a fact that is thought to be largely responsible for a greatly reduced curing time, even less than the curing cycle which has been so widely publicized for other types of high-frequency molding.

This statement of cause and effect may be open to some disagreement. In jet molding, the theory has been that partially softened material is squirted through a superheated nozzle and, during its passage through this nozzle, picks up sufficient heat so that the length of cure necessary in the heated mold is greatly reduced. Another method akin to jet molding makes use of a plate heated to a cherry-red. In this case, the material is squirted through a nozzle so that it impinges on this hot plate, after which the injection pressure carries it through to the mold. The theory in both of these cases is the same—that the brief contact with a very hot piece of metal transfers sufficient heat to the plastic material to almost completely polymerize it before it gets to the mold.

In contrast, the theory propounded for this "plunger" process is that the terrifically high friction created on the material as it is forced through this tiny 0.015-in. orifice, or gate, results in the material becoming almost completely polymerized before it gets to the mold. An engineer of the Bryant Electric Co. has stated that cures as low as 5 sec. have given completely satisfactory commercial parts. Figure 3 shows a section view of this part, a duplex receptacle. Some of the sections in this piece are as thick as $^{1}/_{4}$ in., yet in no instance was blistering observed.

Another factor which tends to prove the theory that the temperature rise occurs as the material passes through the gate is the preheating of the preforms by the generator for only 15 sec. instead of their being preheated to a fairly high temperature. A needle-type pyrometer has indicated that the internal temperature of these preforms is only 275° F. at the time they are loaded into the pot.

The fact that this process does not require as high a preform temperature as other high-frequency molding methods, results in a more stable preheated preform. The preform can remain in the pot for a longer period of time before being injected than can a preform which has been heated by high frequency to a higher temperature. One of the reasons advanced for this comparatively low preheat temperature is that the condition of the material is important to this process. If the material is preheated to 325 or 350° F., it will become soft and mushy. Under these circumstances, sufficient pressure cannot be built up in the pot and runners. Rather, being almost liquid, the material will squirt through the gates with a minimum of press effort. At the lower temperature, however, the material is in a more granular state and, as such, resists passage through the gates to the extent that injection pressures on the order of 6000 p.s.i. are built up.

3—Parts with a wall thickness of ¼ in., like this receptacle which is shown here in section, have been completely cured in as short a time as 5 seconds. 4—This radial-type mold design is capable of producing 6 melamine duplex receptacles in one shot when this "Hy-speed" plunger molding process is employed

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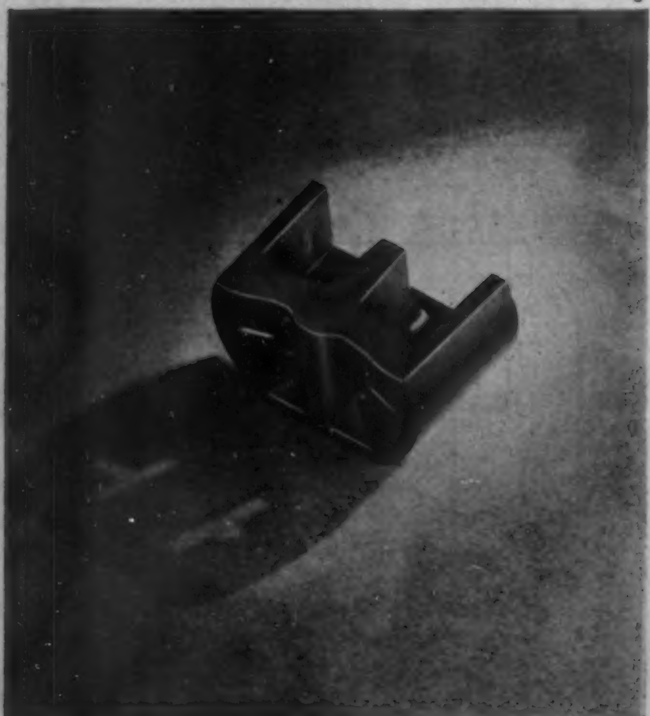

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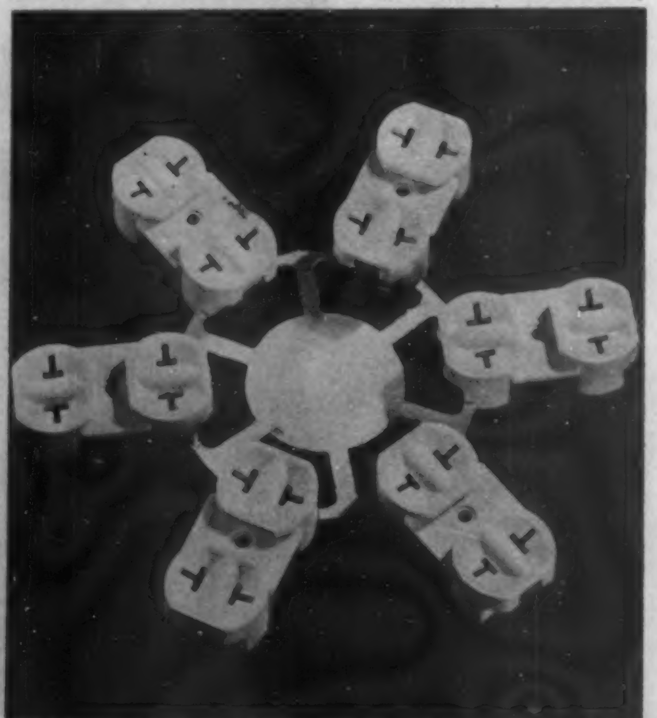

The 6000 p.s.i. figure is not arbitrary, but rather the result of a good many experiments with varying injection pressures and various preform preheat temperatures. Experience has indicated that the 6000-lb. figure is probably the maximum that would ever be needed and that the proper procedure to follow in attempting to set a cycle for a new job is to start on 6000 lb. and then gradually reduce this pressure until the cavities no longer fill out. Then, the pressure should be increased in gradual increments until the cavities are completely filled. This final pressure becomes standard whenever the same job is run, provided, of course, the number of cavities, the material and the length of time the preforms are preheated by high frequency remain the same. With this correct injection pressure, fins and flash are reduced to a minimum and no burrs are visible wherever interlocking pins may have been used to mold through holes.

Another decided advantage to be gained from the use of this new process is that thin and fragile pins are not liable to bend or break. A case in point are the meter box covers (Fig. 10) which were produced in a 2-cavity mold. The material used for these covers was a slate-filled phenol-formaldehyde which, under normal conditions, is rather difficult material to mold. Formerly, this job was run in a 9-cavity compression mold, and great difficulty was experienced with several of the small pins which were used to mold through holes 0.055 in. in diameter. This pin-breaking difficulty became so troublesome that the pins were eliminated and a jig drilling operation set up for boring the necessary holes. With this new process, however, no difficulty whatsoever has been experienced with the pins and company engineers attribute this fact to the absolute control of injection pressure and temperature of the preforms made possible by this new development.

Some interesting figures came to light in a comparison of production times and costs for this meter box cover. When

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the part was produced by compression from a 9-cavity mold, the total cycle was 5.42 min., of which 3 min. was cure time and 2.42 min. was open or bench time. When the job was changed over to a 2-cavity single-shot injection mold, the total elapsed cycle consumed 46 seconds. Fifteen of these seconds were taken up with cure time and 31 seconds were consumed by the balance of the operations such as removing the parts from the mold, blowing flash from the mold, loading

5—The first step in the molding of meter box covers involves the placing of 4 preforms between the electrodes of the 2-kw. oscillator. 6—While the preforms are being heated, the press is in the open position. 7—Before the 4 preheated preforms are loaded into the fixture, the 2 halves of the mold are closed

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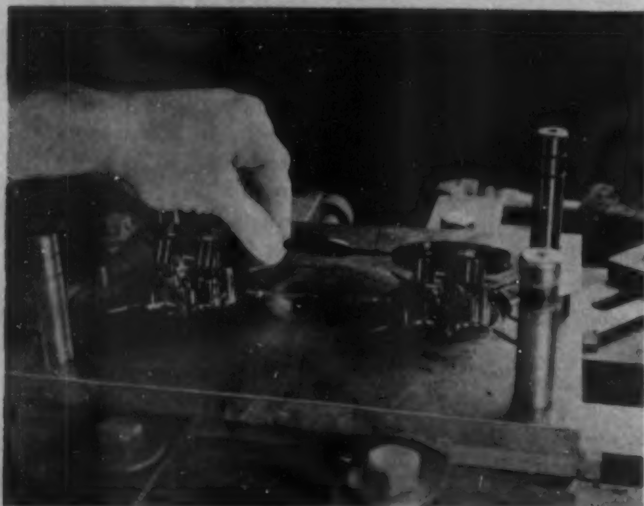

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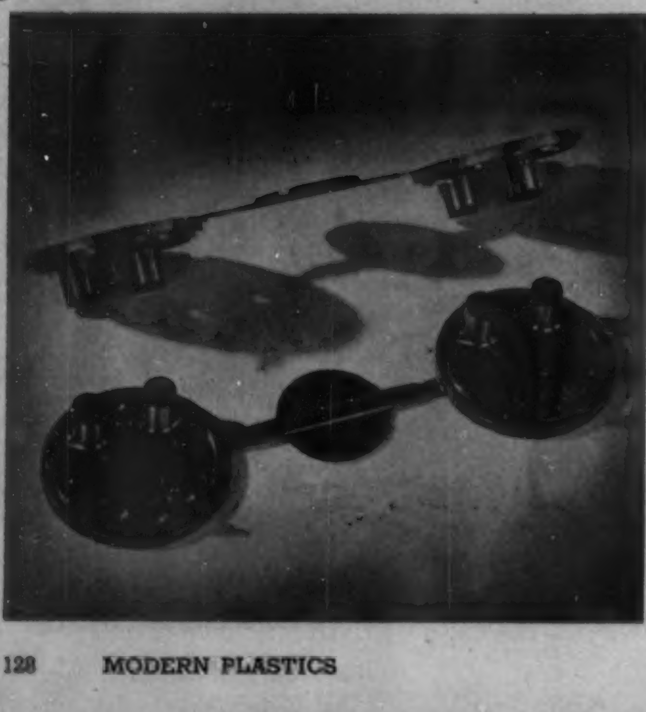

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the preforms of the material into the pot and injection time.

It is not possible to state the selling price of these meter box covers when produced in the 9-cavity compression mold and in the 2-cavity single-shot injection mold, but the company has stated that by the new process the 2-cavity mold effects enough saving to warrant a reduction of $20 per thousand to their customer. Most molders, if they are at all experienced in approximate prices for parts of this type, will be able to estimate approximately the selling price of these parts when produced in a 9-cavity compression mold. They can, therefore, appreciate what a high percentage of the price a $20 per thousand reduction represents.

The sequence of operations in this new process is quite clearly shown by the series of photographs, Figs. 5 through 9. In Fig. 5, an operator is placing 4 preforms between the electrodes of the 2-kw. generator. With the cage in the open position, as shown, there can never be any power in the electrodes inasmuch as the switch (pictured in the lower right-hand corner of both the lid and the case) will make the circuit only when the cover is closed. An automatic timer, which has been pre-set, controls the length of time the preforms will be subjected to the radio-frequency current. The press is in the open position in Fig. 6—the injection plunger raised and the two halves of the mold parted. The first operation is to close the two halves of the mold, then load the 4 preheated preforms into the loading fixture (Fig. 7). The injection pot as well as the plunger can be seen in the center background of this same figure. The operator merely slides the loading fixture along its track until it is directly over the injection chamber whereupon the preforms drop through the bottom of the loading fixture into the injection chamber.

Figure 8 is a side view of the equipment showing the two halves of the mold in the closed position and the loading fixture in the loading position. Once this fixture has delivered its preforms to the injection chamber it is retracted and hydraulic pressure applied to the injection ram. With a speed and pressure which have previously been determined, the ram descends to inject the material into the cavities of the mold. After the proper curing time has elapsed, the two mold halves are parted, knock-out pins raise the molded parts from the lower half of the mold and the molded parts are removed (Fig. 9). The complete absence of flash and sprue are clearly evident in Fig. 9. Figure 10 is a close-up of two shots from this same mold. The shot in the upper half of the photograph is turned on edge so that the thinness of the runners, slugs and gates can be seen. It might be well to note the wall section of the lugs in this piece, keeping in mind the fact that the curing cycle was but 15 seconds.

This molding company has not fallen into the all too common error of giving premature publicity to new processes or new materials. Although the results obtained from the molding of these meter box covers would normally be sufficient proof of the success of this new process, the company decided that additional tests on different types of pieces should be run before any mention was made of their work. Therefore, a mold was produced for a duplex receptacle, and tests were run using a general-purpose woodflour-filled phenolic

8—This side view of the press equipment shows the 2 halves of the mold in the closed position and the loading fixture in the loading position. **9**—*After the proper curing cycle, knock-out pins raise the molded parts from the lower half of the mold.* **10**—*The thinness of the gates and the runners as well as the complete absence of any sprue are evident in this photograph*

material. This piece, shown in section in Fig. 3, was produced by standard compression molding as well as by the new method. Some interesting figures resulted.

	Cure	*Resulting Specific Gravity*	*Water Absorption percent*
Compression molding	$1\frac{3}{4}$ min.	1.330	0.78
"Hy-Speed" plunger molding	10 sec.	1.384	0.27

The decided decrease in water absorption which resulted from an increase of approximately 4 percent in specific gravity is worthy of note. With a job such as this duplex receptable, water absorption is of great importance. The fact that this all-important property can be bettered at the same time that the cure time is reduced from 105 to 10 sec. would appear to add reliable information to the fact that this process has marked advantages. As a matter of record, some completely commercial receptacles were produced after being cured for as little as 5 seconds.

Figure 11 shows 3 phenolic water bottle stoppers which have been produced by compression for a good many years. In view of the fact that the stoppers were standard items, this molder had a great deal of experience in producing them. Nevertheless, there were some difficulties which seemed impossible of solution when these parts were molded by compression. Due to heavy flash or other reasons beyond their control, the O.D. of the thread of these stoppers was sometimes found to be over the maximum permitted by the tolerances. In order to be sure that no shipment went out with oversized stoppers, it was necessary to ring gage the parts 100 percent. With the new process, this problem disappeared completely and with it went the expense of this ring gaging.

In comparing tool costs and production for this job, it was found that the 50-cavity compression mold, which had been producing these stoppers for some time, had originally cost $5150. It was estimated that to approximate the production resulting from this 50-cavity mold, it would be necessary in using the new process to build a 10-cavity mold. This mold cost $1720. The savings here are quite apparent. In production, the 50-cavity mold turned out an average of 3800 parts every 8 hours, whereas a mold one-fifth that size, when operated with radio-frequency preheating and injection molding, produced 4240 parts in 8 hours. In other words, the change-over to the new process brought an increase in production of $33\frac{1}{3}$ percent using a mold one-fifth the size of the one used for compression.

There is no doubt that this company could continue testing and experimenting, and that all the jobs would, in all probability, show up in the same general manner. It would appear, therefore, that this method of molding, if properly carried out, will effect very marked savings in production costs and, at the same time, reduce the original mold cost. In addition, the company estimates a 12 percent material saving as compared with any similar type of molding. Inasmuch as the pressures in the molds themselves are reduced, savings in mold maintenance should approximate 30 percent.

Since the flow of the material in the molds is under relatively low pressure in this new process, the abrasive action against the mold surface is nowhere near as marked as in other molding methods. This fact, coupled with the lower pressure, makes possible the use of chrome-plated cast-iron molds, possibly even beryllium copper for short runs. Hardened steel will only be necessary for the pressure pad underneath the injection chamber and for the section in which the gates and runners are cut.

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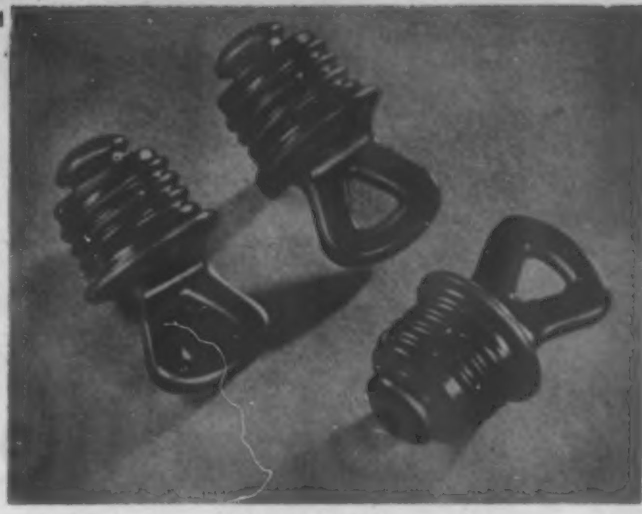

11—When these hot water bottle stoppers were molded by compression, difficulties were encountered with thread tolerance. This problem disappeared when the new molding process was adopted. 12—Top view and section of a proposed 10-cavity mold for the "Hy-speed" molding of the hot water bottle stoppers which are shown in Fig. 11

DRAWING, COURTESY HEMCO PLASTICS DIV., BRYANT ELECTRIC CO

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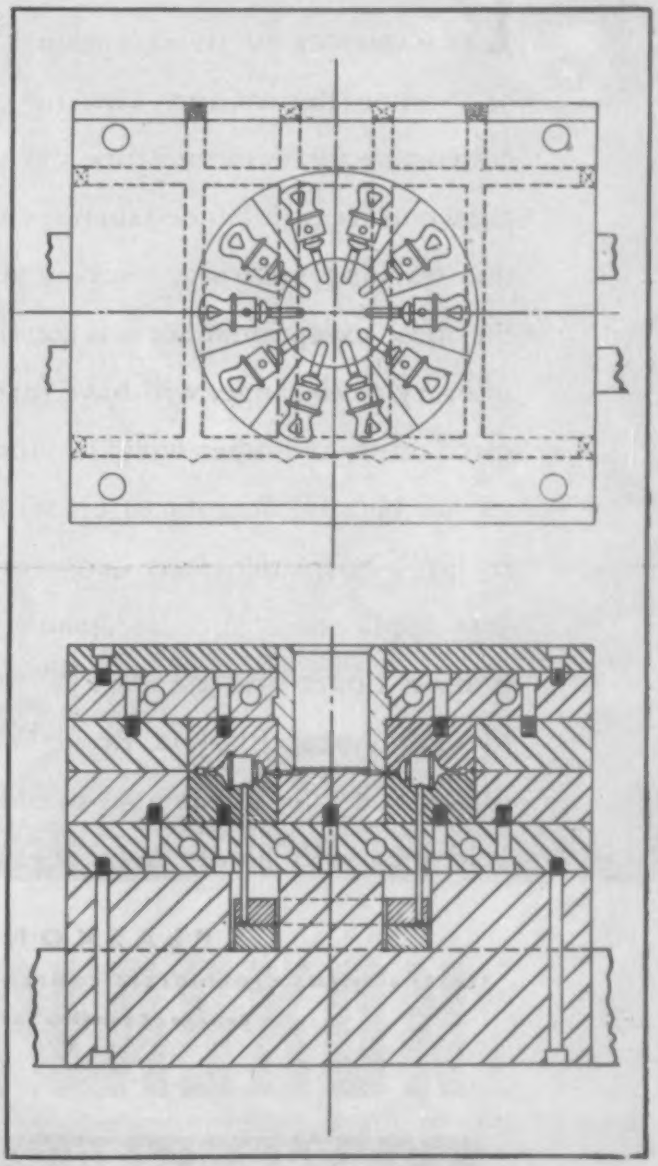


A fast-setting phenolic casting resin

by J. J. PYLE, E. F. FIEDLER and T. V. FERRIS*

THE need for faster tool production in the aircraft industries as well as the necessity for conserving the steel, lead, zinc and other metals commonly used in the fabrication of these tools has been a vital factor in accelerating the adaptation of certain plastics to these applications. The possibilities of using casting resins had been recognized before the pressure of mass production made the change imperative. However, no concentrated effort was made to replace the metals and alloys, primarily, because time was not as important a factor as it is today and secondly, because most experienced tool men felt that only metals could be satisfactory in this type of application.

When the metal shortage became really serious, a reevaluation of plastics indicated that many tools could be made successfully from certain types of thermosetting phenolic resins, which were filled with walnut shell flour, Celite and similar materials. Using plastics, the production of these tools required much less time than was the case when metal was employed. At the same time the change-over in materials resulted in a considerable over-all reduction in cost. Many early difficulties—both mechanical and otherwise—were eliminated through the cooperation of the manufacturer of the resins and the tool men. As a result, the production of cast resin tools has been established and confidence in their use affirmed.

A liquid-type phenolic resin is most commonly used in the preparation of these tools. After being mixed with a suitable filler and an accelerator, the material is poured into appropriate plaster, wood or glass molds and cast in the desired shape. G. E. 1420 casting compound is made from such a resin which is, in turn, prepared from phenol and formaldehyde and a special plasticizer under conditions which result in a low viscosity resin that can readily be set or cured at low temperatures by the addition of the accelerator in relatively small amounts to yield a hard, strong, infusible and insoluble product in a relatively short period of time. The viscosity of this resin is controlled so that it does not exceed 300 C.P. at 25° C. This characteristic allows the addition of as much as 30 percent of walnut shell flour to yield a readily pourable mixture. Higher viscosity resins can be prepared, but these are not considered desirable if fillers are to be used. And in most cases, addition of filler is expedient for reasons of economy.

Fillers or accelerators

Although it is possible to cast the resin without the addition of fillers or accelerator, curing without acceleration must be conducted at a temperature of 70 to 80° C. and requires 4 to 6 days. Castings obtained in this manner are generally harder and stronger than those prepared with accelerator and filler, but they also show higher shrinkages unless cured very slowly at even lower temperatures than those mentioned above. If approximately 7 percent of the accelerator is added to the resin, the cure time will be markedly reduced—to about 13 hr., for example, five of which are at room temperature and eight at 75 to 80° C. Castings made according to this process will have somewhat lower strength characteristics than the castings which require 4 to 6 days to cure but still well above strength requirements generally demanded of stretching and forming dies. Shrinkage will be approximately the same. Use of the recommended amount of filler and accelerator makes possible the production of castings, having satisfactory properties for these applications, in the shortest time. Average characteristics of these three types of material are shown in Table I.

* Plastics Div., General Electric Co.

TABLE I.—COMPARISON OF PROPERTIES OF G. E. 1420 FILLED AND UNFILLED

	No filler or accelerator	*No filler but accelerator*	*Filler and accelerator*
Color	Surface—mahogany Cross section—tan	Surface—orange Cross section—light brown	Surface—reddish brown Cross section—dark tan
Appearance	High gloss, transparent surface	Slightly irregular surface Slightly packed cross section	Dense and smooth
Flexural strength, p.s.i.	4500	3800	3000
Compression strength, p.s.i.	21,500	14,500	8000
Impact strength, Izod, ft./lb.	0.32	0.28	0.25
Water absorption, 24 hr., rm. temp., percent	1.2	1.0	13.2
Cold flow	Nil	Nil	Nil
Specific gravity	1.22	1.16	1.1

Preparation of casting resin

The mixing of the materials is quite simple, but certain precautions must be taken to obtain the best results. When castings with an absolute minimum of pinholes are essential, the mixing should be conducted under vacuum. For most applications, however, satisfactory castings are obtained by placing the resin in a tilting kettle equipped with a stirrer, starting the stirrer, adding the accelerator and, finally, adding the walnut shell flour or other filler and mixing until a homogeneous mass is obtained. If the batch is large, cooling is necessary since considerable heat develops during the mixing after the accelerator is added. If the reaction proceeds too rapidly, the batch forms an art-gum-like mass before it can be poured.

Accelerators

The amount of accelerator that is used naturally has considerable influence upon the base of control of the reaction. While too small an amount considerably retards the cure, an excessive amount results in difficulties during mixing and makes it hard to obtain porous-free castings. It has been found that 8 to 9 percent (0.38 part) of the accelerator is satisfactory when three parts of resin are filled with one part of walnut shell flour. When Celite is used as the filler, the

amount of accelerator can be reduced, advantageously, to 3 or 4 percent (0.158 part).

It should be stressed that to obtain uniform properties in the casting it is essential that the proper amount of accelerator be used. Otherwise, variations in mechanical strength can be expected as well as difficulties with blow holes in the casting. In general, it is better to have the catalyst concentration a little low rather than too high. There are exceptions, however, and it has been noted that within a rather narrow range, i.e., between 3 to 6 percent, the accelerator content is rather critical as regards the behavior of the casting during cure when walnut shell filler is used. If, however, the amount of catalyst is greatly increased—to 10 or 12 percent, for example—quite satisfactory cures are obtained without excessive overheating. No positive explanation for this behavior can be advanced at this time, although it is believed to be due to the rapid formation of a stable lattice which prevents bubbling and porosity. Table II shows that some of the properties of the casting are quire markedly affected by the accelerator concentration used.

Cure of mixtures

Although these mixtures will harden at room temperature, it is very desirable that they be given an oven bake at 75 to 80° C. before they are considered sufficiently cured to develop optimum characteristics. Furthermore, this treatment should be given the casting before final hardening at room temperature occurs since only then do the properties show a definite improvement. Usually about $1^1/_2$ to 2 hr. at room temperature allows sufficient setting before baking to give optimum characteristics for a given mixture. Table III shows the difference between a casting which is hardened completely at room temperature and one hardened by allowing a room temperature set for 1 hr. 40 min. followed by an oven bake at 75° C. for 1 hour. These tests were made two weeks after the castings were completed.

Table III also shows that the time of baking has a marked effect on some of the properties of the casting and suggests that the minimum baking period should be that needed for the casting to come to an equilibrium temperature. This time will vary considerably with the size and shape of the castings, and no definite limit can be established except by experimentation. Usually, however, several hours' bake at 75° C. will have developed strength properties quite sufficient for the general applications.

TABLE II.—COMPARISON OF 13 PERCENT VS. 6 PERCENT ACCELERATOR CONCENTRATION ON PROPERTIES OF G. E. 1420 COMPOUND

	Accelerator, 13 percent	*Accelerator, 6.0 percent*
Shrinkage, mils/in.	4.3×10^{-3}	....
Specific gravity	1.09	1.11
Tensile strength, p.s.i.	1328	1772
Modulus elasticity	$1.06 \times 10^{-}$	2.8×10^{-5}
Compressive strength, p.s.i.	8583	8196
Flexural strength, p.s.i.	2525	2346
Shear strength, p.s.i.	2640	2664
Impact strength, Izod, ft. lb./-in. notch	0.13	0.26
Thermal expansion, in./in./°C.	5.0×10^{-5}	5.9×10^{-5}
Water absorption, 24 hr. rm. temp., percent	18	13.2
Machining qualities	Easily machined, slightly brittle	Very good
Effect of aging	Darkens slightly	Darkens

TABLE III.—COMPARISON OF CASTINGS MADE AT ROOM TEMPERATURE VS. OVEN TEMPERATURE (75–80° C.)
(High accelerator content. Castings 18 in. in Diameter by 8 in. Deep)[a]

	Room temp. cure	*Cure at 75° C.* 1 hr. bake	*2 hr. bake*	*7 hr. bake*
Specific gravity	1.09	1.11	1.09	1.15
Tensile strength, p.s.i.	1390	1750	1330	1510
Compressive strength, p.s.i.	6450	7280	7260	7980
Flexural strength, p.s.i.	205	1882	2525	2257
Shear strength, p.s.i.	2050	2510	2640	3050
Impact strength, ft. lb/in. notch	0.083	0.17	0.13	0.27
Thermal expansion, in./in./-°C. $\times 10^{-5}$	...	5.1	5.0	4.1
Water absorption, 24 hr. rm. temp.	...	18.0	16.2	12.9
Machining properties	Easily machined	Slightly brittle	Same	Very good
Effect of aging	Slowly cracks and darkens	Cracks slightly and darkens	Darkens	Darkens

[a] Time for one of these deep castings to come to equilibrium is determined by embedding thermocouples in the casting at various levels.

Problems of shrinkage

Recently the application of these materials to gage blocks and similar precision fixtures has made necessary the development of casting conditions which would yield finished products showing practically no shrinkage. Since the material shrinks as the result of a chemical change which takes place during the curing period and cannot normally be stopped without stopping the reaction, it became necessary to find some other means of overcoming this condition. Certain types of fillers have been found that reduce the normal shrinkage, which varies from approximately 0.5 to 0.25 or 0.3 percent. Included in these fillers is Celite, a finely ground asbestos and talc. In the effort to reduce the shrinkage still further, various methods of controlling the rate of cure and of preparation of the mold, etc., have given some measure of success. Elimination of a parting agent in the mold allows the mass to adhere to the walls of the mold and prevents lateral shrinkage—a procedure which has proved quite successful for certain small castings. A lower accelerator content, which results in a slower rate of cure, has also been helpful. In general, whenever close tolerances are required it is necessary to try several small-scale experiments using a combination of the above factors to determine which filler and condition will yield a satisfactory product. In large sized parts, these problems are not so serious.

Voids in the casting

In castings where an absolute minimum of pinholes and shrinkage is desired it has been found very beneficial for both large and small castings to prepare the mixture under vacuum. As a further step in eliminating pinholes, which are usually caused by entrapped air, vigorous vibration of the casting immediately after pouring is recommended. The viscosity of the mixture is of (*Please turn to page 190*)

Beetle the Plastic that's all Color in all Colors

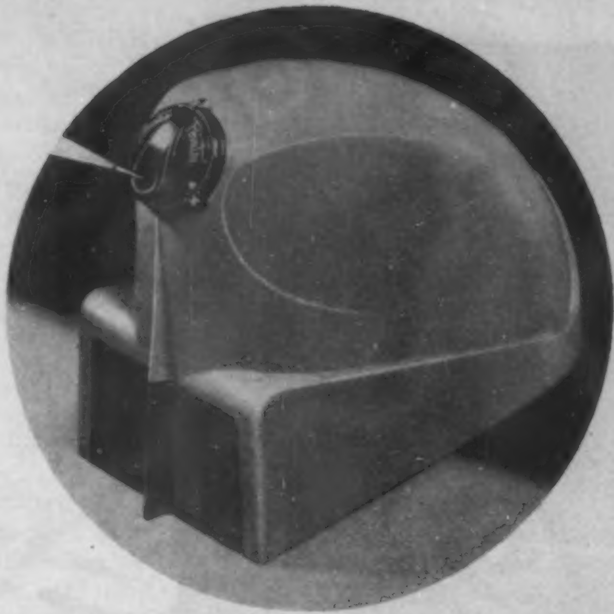
Plastic radio cabinet molded for Emerson Radio and Phonograph Corporation by Plastimold, Inc.

All basic requirements of a successful product housing material are found in BEETLE*. Its brilliant, wide range of colors can be utilized in design for customer appeal and design efficiency. Its surface is smooth and wear-resistant. Its clean, smart appearance and colorful finish last the life of the product. BEETLE has natural insulating properties against heat and electricity. Its adaptability for low cost, volume production enables products to compete profitably on a broad consumer market. Housings are quickly, accurately molded. BEETLE offers a combination of unmatched advantages for modern, distinctive, efficient product housings. Complete information contained in the booklet, "BEETLE Molding Materials," will be sent on request. *Reg. U. S. Pat. Off.

LIFE ON THE PLASTICS NEWSFRONT

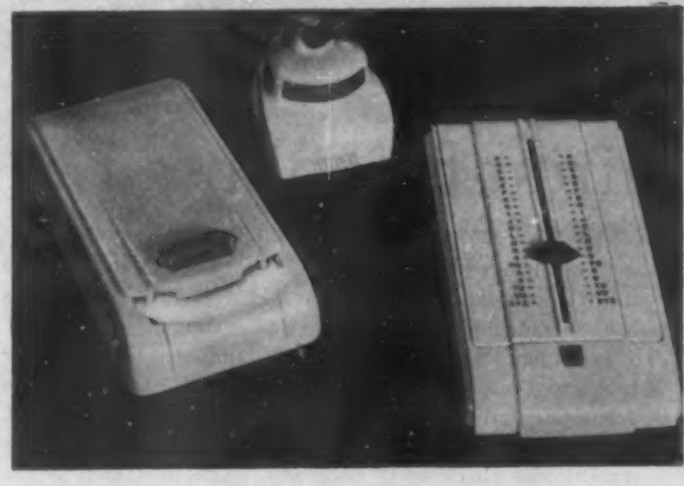
AMERICAN CYANAMID COMPANY • PLASTICS DIVISION
30 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

Prewar Developments that Point to Postwar Trends in Colorful Plastic Design

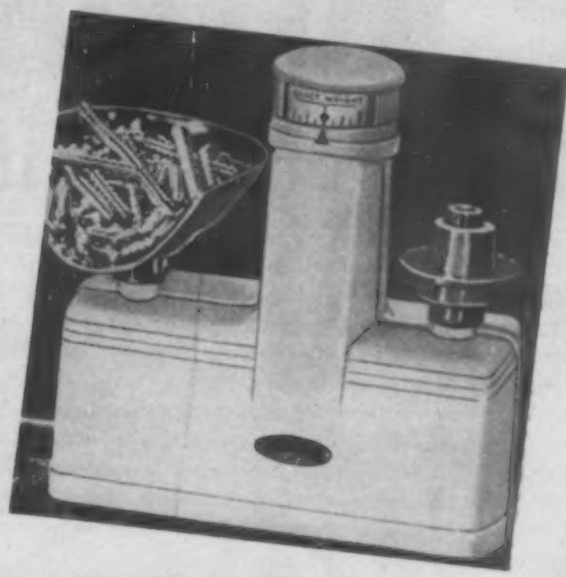


(*Above*) **DISTINCTIVE DESIGNS** are molded with ease and economy as in the attractive and colorful BEETLE housing of this Electro-Pointer pencil sharpener, molded by Kurz-Kasch, Inc.

(*Above*) **SMART, QUALITY APPEARANCE** is achieved on an economical, large-volume basis in the Hammond electric clocks by use of BEETLE housings, molded by Chicago Molded Products Co.



(*Above*) **COLOR** for practical and decorative purposes is illustrated in these Zephyr desk set housings which are virtually ready for assembly as they come complete from the mold.



(*Above*) **FUNCTIONAL EFFICIENCY** was improved, costs cut and weight reduced with these Exact Weight Scales BEETLE housings, molded by Kurz-Kasch, Inc.

(*Above*) **SMOOTH, WEAR-RESISTANT** surface, sound-deadening and insulating properties of BEETLE proved ideal for Schick Shaver housings, molded by Shaw Insulator Co.

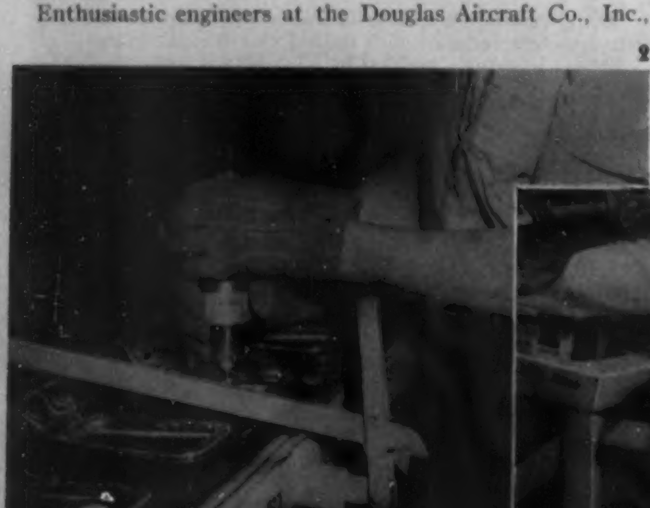
ALL PHOTOS COURTESY DOUGLAS AIRCRAFT CO., INC.

Plastic laminates in aircraft tooling

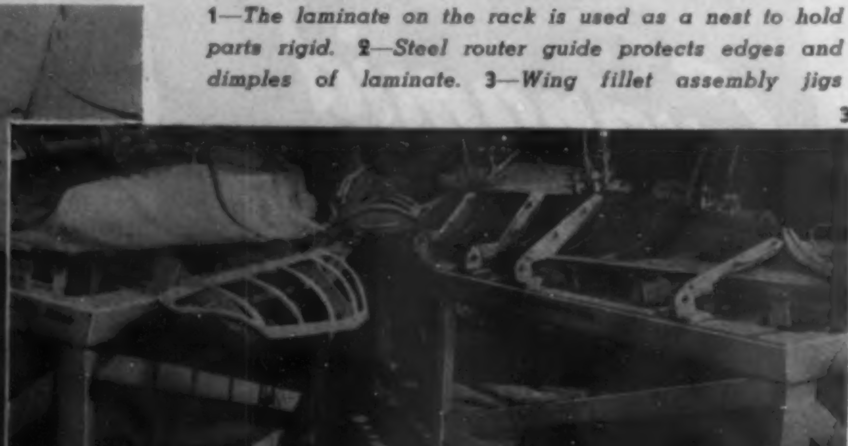
THE ease with which plastic laminates can be fabricated into complex shapes and contours and the low cost of manufacturing equipment are earning for these materials an indispensable place in the field of aircraft tooling. Due to the light weight of plastic laminated tools, they can be easily handled by women workers. Another important feature is the fact that plastic laminated tools can be functioning on the production line within a few hours after being conceived. That they have effected a saving of thousands of man hours while making possible a tremendous reduction in manufacturing cost, is obvious.

Enthusiastic engineers at the Douglas Aircraft Co., Inc., were quick to realize the advantages of plastic laminates for tooling purposes. Among their applications of plastics are laminated drill jigs, router blocks and nesting dies.

Preliminary to the fabrication of a laminated tool, a master plaster pattern is made. All trim lines and other details are accurately scribed onto this mock-up with indelible pencil. These lines are used for permanent reference and whatever dimensional checking is necessary. The next step is the lifting of a plaster shell from the master plaster pattern. Long hemp fibers, asbestos or other binding materials are mixed into the soft plaster before it is spread over the master



1—The laminate on the rack is used as a nest to hold parts rigid. 2—Steel router guide protects edges and dimples of laminate. 3—Wing fillet assembly jigs



pattern. It is essential that the plaster be thoroughly mixed. The plaster shell should be well braced to prevent breaking and to insure sufficient strength to withstand the stresses incidental to the various operations connected with the fabrication of the tool. Surface marks or voids caused by the failure of the plaster to adhere smoothly to the surface of the pattern are filled, then sandpapered. The shell is placed in an oven and dried for approximately 6 hr. at a temperature of 100 to 150° F.

Prior to the preliminary operations of fabricating the tool, the plaster shell receives three or four applications of mold coating which act as a parting agent. The type of coating used in this plant dries in about 15 minutes. Each application is allowed to become thoroughly dry before the next coat.

Mixing a predetermined amount of liquid phenolic casting resin with 15 percent acid catalyst and ground asbestos is the first step in the fabrication of the plastic tool. These materials are thoroughly stirred together and should be of a consistency similar to house plaster. A basic coat of this material, approximately $^1/_4$ in. in thickness, is spread over the surface of the plaster shell. This coat is well troweled onto the surface in order to work out possible voids or bubbles. Strips of glass cloth are used for the laminated sections of the tool. A sufficient number of these sections (cut to the correct size and shape) are prepared before the plastic materials are mixed.

A strip of the glass cloth is placed over the face coat of plastic, and brushed or pressed over the surface in order to eliminate wrinkles or small air pockets. After this first section of the laminate has been allowed to dry, a very thin coat of pure resin and catalyst is brushed vigorously into the mesh of the glass cloth. The second ply of glass cloth is immediately rubbed into freshly applied laminating varnish. Four to six layers of plys of glass cloth are applied in the same manner—the number determined by the stress requirements of the tool.

The laminate is backed up with an outer base consisting of plywood strips which are applied in the same manner as the laminated sections of glass cloth. Curing or baking the laminate is the final operation. This is accomplished by allowing it to cure in an oven for from 6 to 12 hr. at an approximate temperature of 180° F.

Metal bushings for the protection of the edges of drill holes and maintenance of accuracy are built into such tools as the laminated drill hoods and drill jigs. The locations for these bushings are first scribed on the master plaster pattern or mock-up. Two types of bushings are used—one of hard metal and the other of a soft metal known as cerrametrix which melts at a temperature of approximately 212° F. It is possible to build these bushings into the laminate during its fabrication or to insert them after completion of the tool. Due to the soft quality of the metal it is necessary to exercise care when the tool is in use in order to avoid nicking and cutting the inner surface and edges of the bushing.

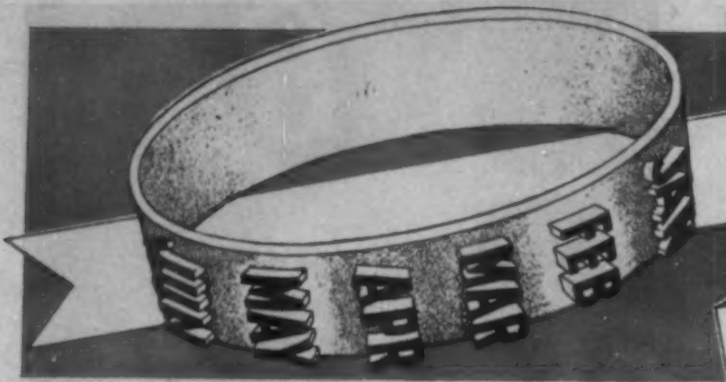
There are certain advantages in the use of soft metal bushings. In the event of changes (*Please turn to page 202*)

4


5


6


4—This laminated plastic drill hood for an assembly jig hinges down over a preformed dural part. The laminate is fitted with bushings through which holes are located and drilled. 5—Four layers of glass cloth make up this laminate. This serves as a nest for a stretch press. 6. The inside (left) and outside (right) of a plastic laminated nesting fixture for an assembly jig



SPRING RINGS FOR SIDE MARKINGS

by JOHN H. BURKAM*

SIDE markings on plastic parts are usually produced by means of loose pieces which are ejected with the part. However, when the article in question is circular, with accurate markings around the periphery, the loose block method is not practical because it is expensive in operation and upkeep, and does not produce a smooth accurate surface.

A Dayton, Ohio, company uses many round articles of this type which range from $^5/_8$ to $3^1/_4$ in. in diameter. To meet its needs a new and very satisfactory method of molding side markings has been developed. The loose part of the mold which produces the markings is a spring ring open at one point (Fig. 1) and with a diameter of such dimensions that when the ring is placed in the mold it is completely closed. The ring is the same width as the finished part and of sufficient thickness to give it the proper tension for springing open when ejected with the part—thus freeing itself from the markings.

Since the markings must be precisely located, the ring has a milled form, at the point where it is parted, which fits a pin in the mold. This spring ring will mold perfect characters and a clean smooth background except for a faint line where the ring is divided. Raised characters in the ring will produce sunken characters on the product, while ring characters that are sunken will produce raised markings on the finished plastic part. This method is practical in the injection molding of thermoplastic materials and the transfer molding of thermosetting plastics; but not so with compression molding because of excessive internal pressures and the fact that material gets in back of the ring.

While anyone with only slight molding experience could figure out the facts presented in the preceding paragraphs, the method of producing the markings on the inside of the spring ring are not so easily established. Assume that the part to be molded is 0.4062 in. in thickness with an outside diameter of 2.625 inches. The months of the year are in sunken characters 0.012 in. deep on the periphery of the piece—these markings to be subsequently filled with paint (Fig. 2).

The inside diameter of the closed ring in the mold will be 2.638 in. which allows 0.013 in. for cold mold to cold piece shrinkage. The inside diameter of the open ring (Fig. 1) is figured as follows: The closed position is 2.638 in. in diameter—giving a circumference of 8.2875 inches. Add 0.1875 in. for the gap, and the circumference of the open ring is increased to 8.4750 in. which means that the inside diameter of the open ring is 2.698 inches.

The plain cavity in the mold (Fig. 3) will be 2.763 in. in diameter, which allows 0.062 in. all around for the ring and 0.001 in. extra.

* Tool Design Div., National Cash Register Co.

1—*A new and successful method of molding side markings on circular plastic parts employs a spring ring open at one point and with a diameter of such dimensions that when the ring is placed in the mold it is completely closed*

The swaging method

There are two methods for making this spring ring—one by swaging and the other by the electro process. For the swaged ring the first step is the production of a tool-steel mandrel (Fig. 4). This must be of high-grade tool steel properly hardened to withstand the pressure exerted on it when swaging. The outside diameter is 2.706 in.—0.008 in. larger than the inside of the open ring to allow a certain amount of space for shrinkage in hardening and about 0.006 in. for grinding.

The characters are engraved, about 0.015 in. deep, in a line around the periphery of the mandrel after which the piece is oil hardened and ground to size, leaving the markings 0.012 in. deep. A soft steel ring (Fig. 4) is prepared as follows: A piece of cold-drawn or cold-rolled steel, $^1/_4$ by $^9/_{16}$ by about 8 in. long (*a*) is formed into a ring about 2.563 in. in inside diameter. The gap (*b*) is then arc welded. Next the ring is machined until the inside diameter measures 2.698 in.—to fit over the engraved part of the mandrel—the outside diameter of ring 2.875 in. and the width 0.50 inch. The shoulder (*c*) is designed to give the ring the proper support on the mandrel. By employing this construction whereby the grain of the steel runs in a circular direction,

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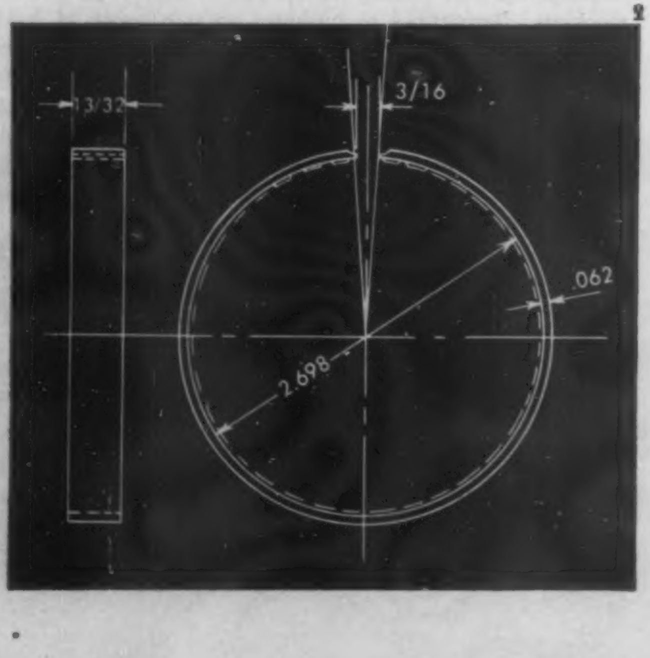

shrinkage of the ring after swaging is eliminated while the flexibility of the ring is, at the same time, maintained.

The swaging equipment (Fig. 5) consists of a die (*a*), which is pressed into a bull ring (*b*) for strength, and a punch (*c*) which fits rather snugly into the die and over the reduced portion of the mandrel. The punch and die are hardened and ground. When about 20 tons of pressure are applied to the punch, the soft steel ring (*d*) becomes plastic and flows into the engraved characters. The rubber cushion (*e*) is designed to support the mandrel and at the same time allow it to have a slight downward movement. This arrangement obviates any shearing action on the characters as they are formed.

After swaging, the mandrel and soft steel ring are removed and put between centers so that the swaged ring can be machined to size—the outside diameter being 2.822 in. and the width 0.406 inch. The measurement for the width is taken from the lower edge. A formed milling cutter is used for parting the ring. This cut is made at a predetermined location on the ring between certain characters, and a corresponding mark (*f*) is cut on the mandrel to indicate this location. When the ring is placed on the mandrel for swaging, care is exercised to locate the weld spot in line with the cut-off mark, so that the weld will subsequently be cut away.

As soon as the ring is parted it can be sprung open and removed from the mandrel. Its inside surface will be an exact duplicate of the engraved mandrel. Heat treating of the ring is not necessary, but a flash of chrome plating is recommended. While this swaging method gives great accuracy of dimensions and character spacing, it is quite expensive.

The electro method

The electro ring, now being developed by one of our engineers, is much less expensive and more quickly produced. With this process, the markings which are to appear on the finished product are first set up in a straight line in regular printing type and then locked in a frame. Several such units may be put in one frame, but the length of the line and the spacings must be determined by trial.

From this set-up an impression is made in electrotype wax. It is important that the wax form should be perfect as to characters and background since it will be exactly duplicated in the finished product. On the face of the wax imprint is deposited, by electrolysis, a copper form of proper thickness, allowance being made for machining. When removed from

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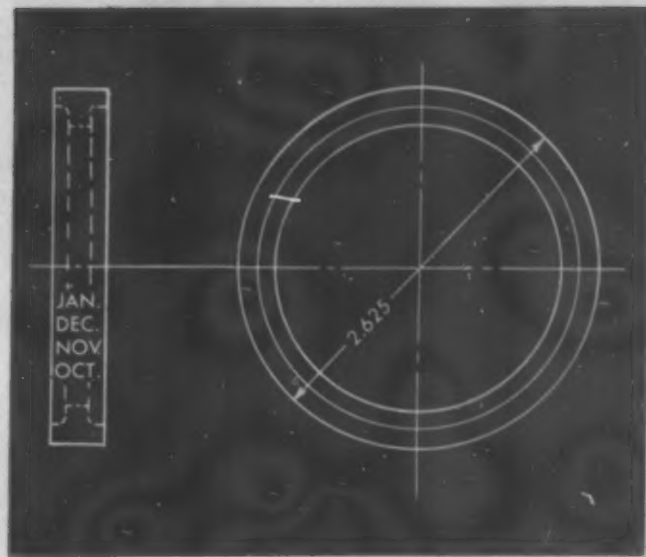

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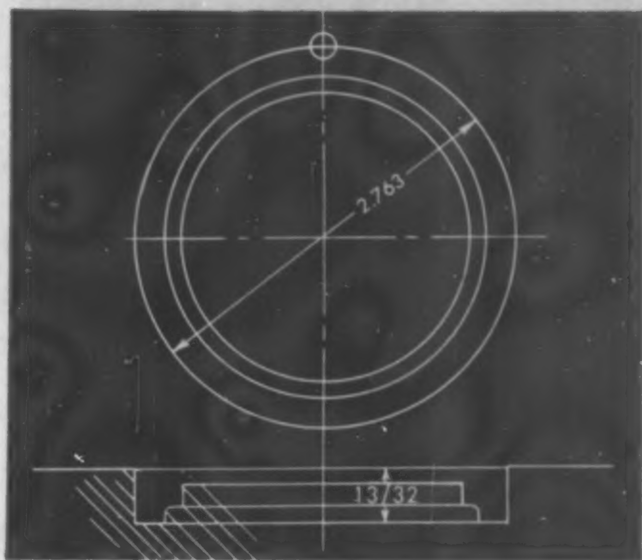
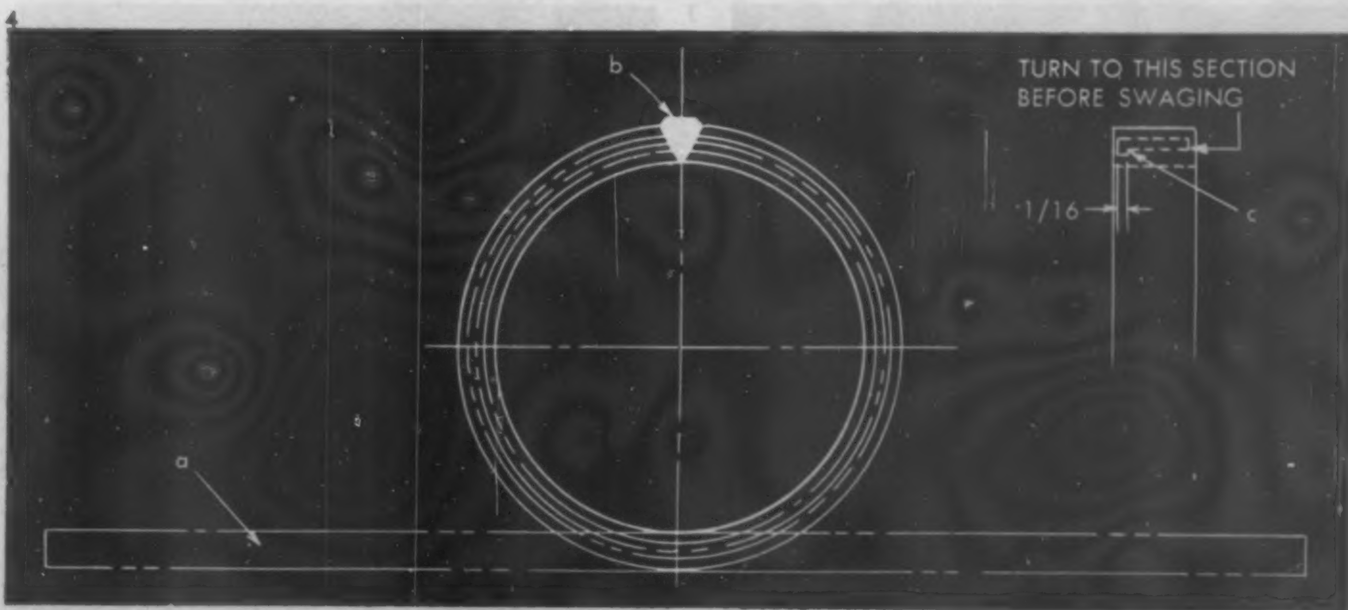
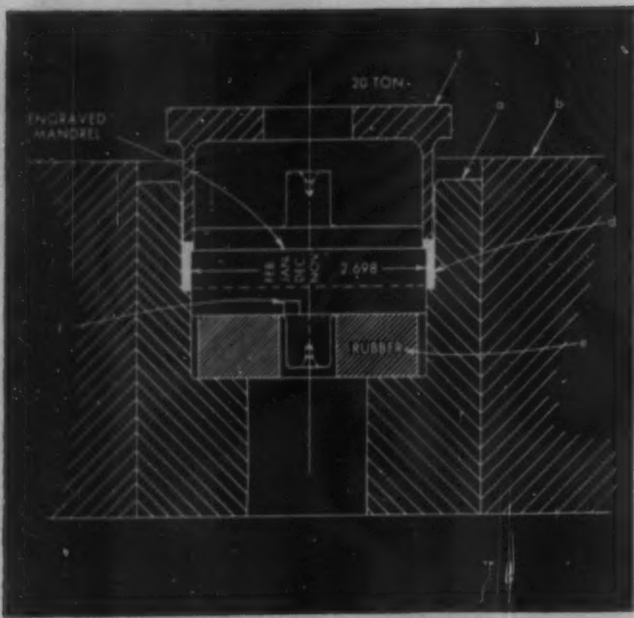


2—The side markings on the molded part are subsequently filled with paint. 3—The diameter of the plain cavity allows 0.062 in. all around for the ring and 0.001 in. extra. 4—A cross-section of the tool-steel mandrel

4





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the wax, the copper is cut into strips about 0.420 in. wide with the markings in the center. Each strip—in case multiples are being made—is placed in a holder and shaved from the back side to a thickness of 0.020 inch. The strip is then carefully formed on a mandrel to a circular shape (Fig. 6) with the markings inside.

While the copper ring is on the mandrel, a specially prepared steel ring is clamped on the outside and soldered securely to the copper. Then the copper and steel rings are removed and the edges dressed smooth and accurate as to width (Fig. 8).

The above-mentioned steel ring is completed in a manner similar to the ring shown in Fig. 4. The difference lies in the sizes. Cold-drawn steel, 0.1875 by 0.50 in., is used. It is formed to a circle with an outside diameter of 2.9375 in., and arc welded (Fig. 7). Then it is turned to an inside diameter of 2.738 in., outside diameter of 2.822 in., a width of 0.406 inch. Next the ring is parted at the welded point with a formed cutter, and the inside surface tinned ready for sweating on to the copper ring. Care must be exercised to keep the inside of the copper free from solder so that it can be chrome plated.

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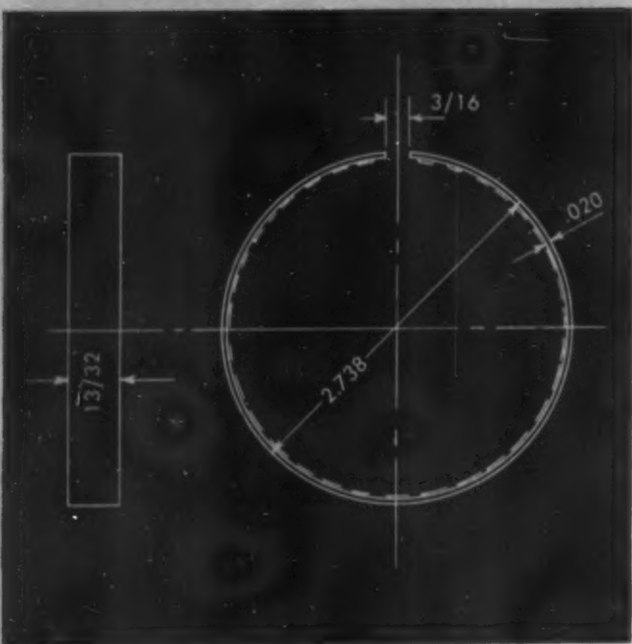

A third method

A variation of this electro method may be used when the production is very low. In such a case, the electro form that is deposited on the wax may be made extra thick so that it can be shaved to 0.062 in.—thus eliminating the outside steel part. Chrome plating adds strength to the piece.

Molds which use the above described springs rings for outside markings should be so constructed that the feed gates are inside rather than over the edge of the ring.

5—The swaging equipment used in one of the two methods of producing spring rings consists of a die (a), a bull ring (b), a punch (c), a soft steel ring (d) and a rubber cushion (e). 6—In the second method of ring production, an electro is made of the desired markings. This electro, in strip form, is then formed to a circular shape with the markings on the inside. 7—A steel ring to go outside the copper ring is formed to a circle and arc welded. 8—After the steel ring has been sweated onto the copper ring, the edges of both are dressed smooth

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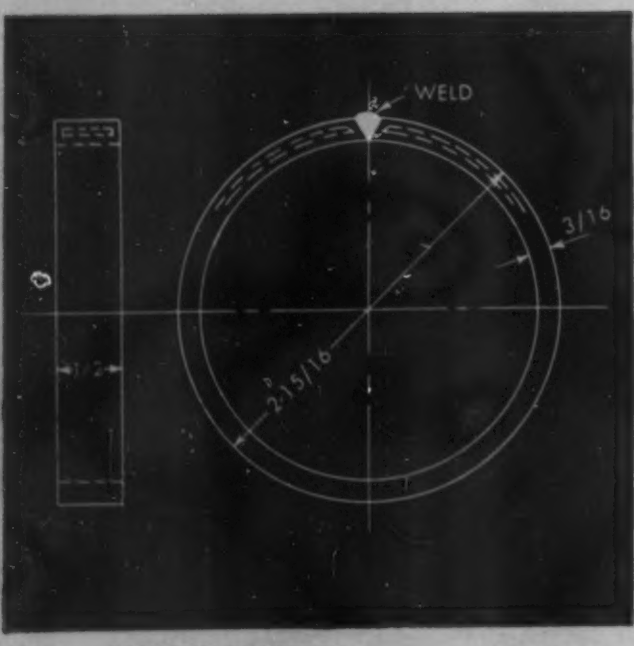

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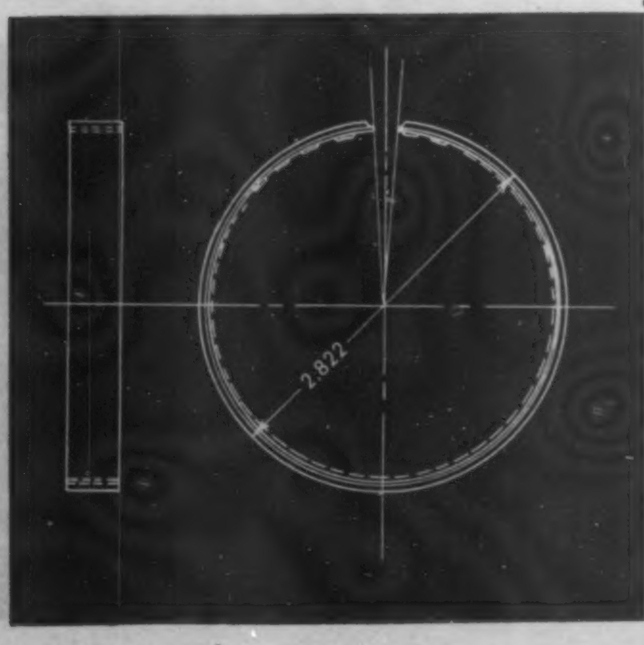


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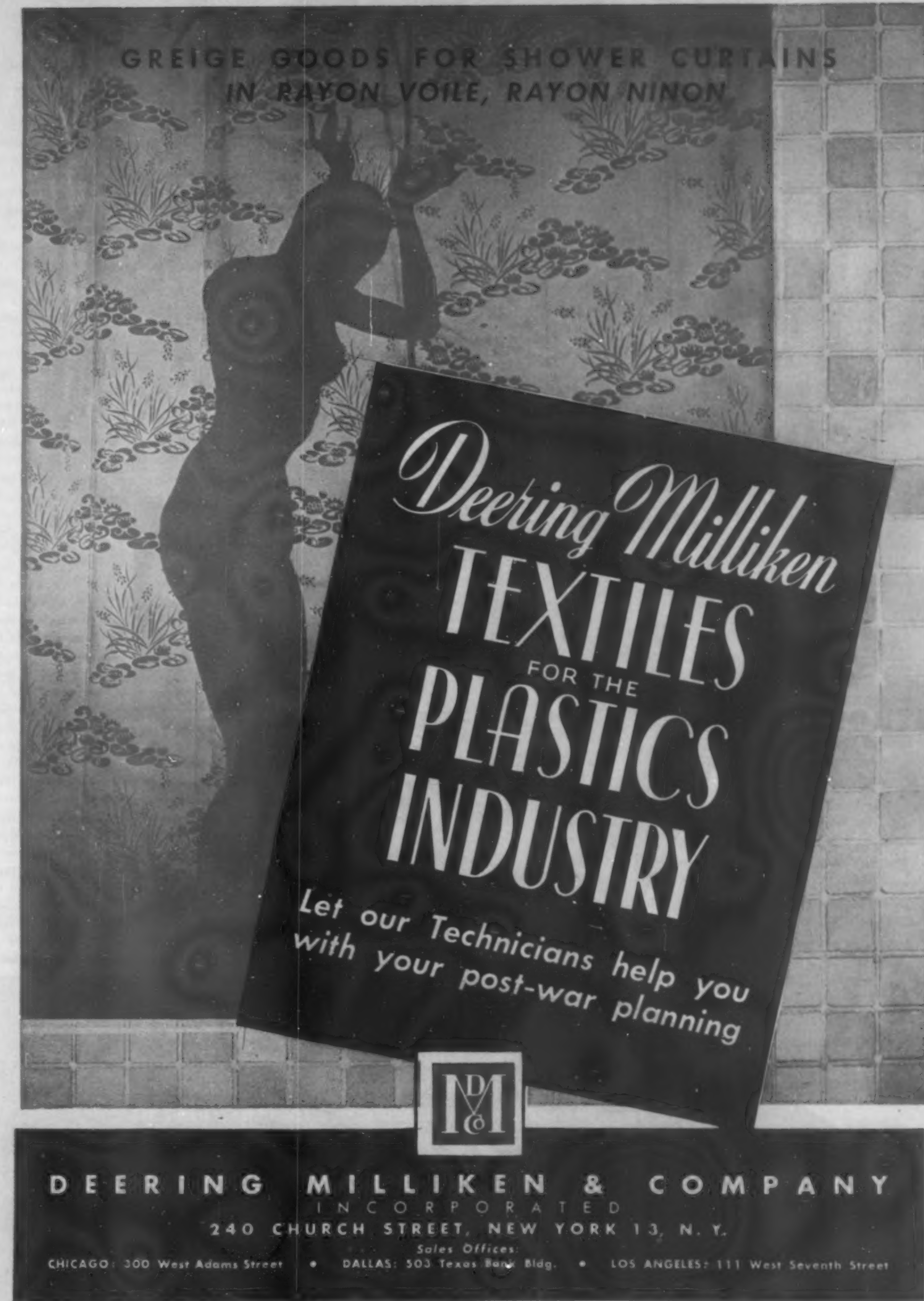
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Physical strength properties of molded fiber-resin preformed materials

by R. H. MOSHER and J. B. GRIFFIN*

WITHIN the last 2 years, there has been a decided growth of interest in the "pulp molding" process, both as a method of producing small articles possessing exceptional physical strength characteristics and as a means of molding large objects which have up to now been either extremely difficult or impossible to produce using conventional molding techniques and materials.[1-3] The fundamentals of the process are simple and have been covered in previous publications.[4,5]

This work was undertaken to determine the physical properties which could be obtained using various types of molded resin-fiber preforms Numerous commercial fibers and resins were studied, using both impregnation and beater-dispersion methods of resin incorporation. The purpose of the work was to evaluate more thoroughly the possibilities of the process and to determine the best fibers and resin types for use in future development work.

Materials used

Phenolic resin-fiber preforms were prepared by impregnation techniques using the following fibers selected for their strength imparting characteristics: alpha pulp, unbleached sulfite pulp, unbleached kraft pulp, ground wood pulp, defibered rag stock, and an asbestos fiber-glass fiber combination. The unbleached pulps were used because of 1) lower cost, 2) higher inherent physical strengths, and 3) the masking action of the dark phenolic resins on any slight difference in fiber color. Since kraft pulp was found to be the strongest and most suitable base fiber, all further studies which were made to evaluate the various types of phenolic resins were carried out with this material. All of the phenolic resins were standard Resinox[6] materials.

In some applications, colors are necessary and although dark reds, blues, greens, and all shades of black and brown can be obtained with phenolic-type resins, the melamines are required to produce light colors and pastel shades. For this reason a number of commercial fibers were evaluated using a melamine-phenolic resin combination. Preforms were prepared using alpha pulp, defibered rag stock, bleached sulfite pulp, and some combinations of the above with tire cord in order to obtain increased impact strength. The prime requisite for these fibers was light color. The resins used in the preparation of these preforms were standard Resimene[6] and Resinox materials.

Much has been said and published concerning the various lignin-cellulose compounds as extenders and fillers, so some lignin enriched filler was preformed and molded. This could be a cheap source of fiber. Since the compound already contains a thermoplastic resin, the additional amount of phenolic resin which would be required could be held to a minimum.

Preparation and molding of preforms

Impregnated resin-fiber preforms—The various pulps and fibers were prepared for preforming by breaking down in the beater. The treatment ranged from the few minutes required to break up the sheets of ground wood and lignin-enriched filler into individual fibers, to half an hour to soften and wet the Kraft pulp, to 2 hr. to defiber and cut up the rag stock. This was done in order that the maximum drainage and feltability of the fibers might be obtained. In all cases, practically no hydration of the fibers occurred.

The 5 by 7-in. slab preforms were felted by using vacuum technique.[5] The preform weight was controlled by the consistency in the felting tank and the time of immersion of the felting screen. The preforms were removed from the screen by the use of compressed air. The water in the wet preforms was then removed in a circulating-air oven. The oven-dried preforms were impregnated with a solution of the resin. The pickup was carefully controlled to ±1 percent of the desired value. The solvent was removed and the resin advanced to the moldable state in a circulating-air oven.

A portion of the lignin-enriched-filler preforms was dried to residual moisture contents of 5 and 10 percent, and stored in sealed containers for molding.

Beater-dispersed resin-fiber preforms—The resin was dispersed in the beater, as the pulp circulated, by addition through a fine-mesh screen. This procedure eliminated the presence of any lumps and gave the best distribution of the resin. The mixture was then circulated for 10 min. to obtain complete dispersion.

The preforms were prepared as previously described and the water was removed in a circulating-air oven. Care was taken not to advance the resin to any appreciable extent.

Molding of preforms—The preforms were cured in a 5

* Research Dept., Plastics Div., Monsanto Chemical Co.

[1] J. Delmonte, "Research Activities Hold Promise for Resin-Pulp Combinations," Pacific Pulp and Paper Ind. *18*, 32 (1944).

[2] W. B. Parsons, "Molded Pulp Resin Products," MODERN PLASTICS *19*, 45 (Oct. 1941).

[3] W. B. Parsons, "Down-East Handwheels for Destroyers," MODERN PLASTICS *20*, 61 (Aug. 1943).

[4] R. U. Haslanger and R. H. Mosher, "Phenolic Resin-Pulp Preforms," MODERN PLASTICS *20*, 76 (July 1943).

[5] S. H. A. Young and R. J. Box, "Pulp Preforming and Molding," MODERN PLASTICS *21*, 116 (Dec. 1943).

[6] Trade name, Monsanto Chemical Co.

Table I.—Molding Conditions for Fiber-Resin Preforms

Preform material	*Preform thickness*	*Molding temp.*	*Molding pressure*	*Cure time*	*Remarks*
	in.	*° F.*	*p.s.i.*	*min.*	
Lignin enriched filler (L.E.F.)	0.12	375	6600	5	Cooled in mold to 120° F. before removal
Lignin enriched filler (L.E.F.)	0.50	375	6600	25	
L.E.F. plus phenolic resin	0.12	340	4400	5	Removed hot
L.E.F. plus phenolic resin	0.50	340	4400	30	Removed hot
Impregnated; phenolic resin	0.12	340	2200	5	Removed hot
Impregnated; phenolic resin	0.50	340	2200	30	Removed hot
Impregnated; phenolic resin	0.12	340	4400	5	Removed hot
Impregnated; phenolic resin	0.50	340	4400	30	Removed hot
Impregnated; melamine-phenolic resin	0.12	300	6600	5	Removed hot
Impregnated; melamine-phenolic resin	0.50	300	6600	30	Removed hot
Beater-dispersed; phenolic resin	0.12	340	2200	5	Removed hot
Beater-dispersed; phenolic resin	0.50	340	2200	25	Removed hot
Beater-dispersed; phenolic resin	0.12	340	4400	5	Removed hot
Beater-dispersed; phenolic resin	0.50	340	4400	25	Removed hot

by 7-in. positive-type slab mold. The molding conditions for each type preform can be found in Table I.

Test specimens and procedures

Specimens—The test specimens were machined from the molded slabs according to A.S.T.M. specifications. Specimens for tensile tests were machined from 0.12-in. thick slabs. The flexural bars (0.5 by 0.5 by 5.0 in.) were machined from the 0.5-in. thick slabs and the impact strength determinations were made on the broken halves of these bars. The edgewise compression tests were run on specimens 0.5 by 0.5 by 1 in., cut from the 0.5-in. thick slabs. Water absorption was determined on 1.5-in. square pieces cut from the 0.12-in. thick slabs.

All specimens were conditioned for 48 hr. at 50° ± 3° C. according to A.S.T.M. method D 618–41 T and then stored in a desiccator at a constant temperature of 25° C. until tested.

Test methods—Flexural, compressive and tensile data were obtained on a 10,000-lb. range screw-type universal testing machine with a constant rate of crosshead motion (0.05 in. per min.). Flexural tests were run according to A.S.T.M. tentative method D 650–42 T, tensile tests according to A.S.T.M. tentative method D 638–42 T, and compressive tests according to A.S.T.M. method D 695–42 T.

Impact data were obtained on a pendulum-type impact tester having a range of 100 in.-lb. The Izod method in which the stress is concentrated by use of a notch was used. The tests were made according to A.S.T.M. tentative method D 256–41 T. The water-absorption data were obtained using a 48-hr. immersion of the samples in water at a constant temperature of 24° C. The tests and calculations were made according to A.S.T.M. method D 570–42.

Reliability of data—The mean deviations on all reported values were calculated and may be found in the tables with

Table II.—Effect of Fiber Type on the Physical Strength Properties of Fiber-Resin Preformed Material Containing 45 Percent Phenolic Resin

Preformed fiber	*Molding pressure*	*Specific gravity*	*Flexural properties* Parallel[a] Flexural strength	Parallel[a] Deflection	Perpendicular Flexural strength	Perpendicular Deflection	*Compressive strength, edgewise*	*Impact strength (notched Izod)* Perpendicular	Parallel[b]	*Tensile strength*	*Water absorption*
	p.s.i.		*p.s.i.*	*in.*	*p.s.i.*	*in.*	*p.s.i.*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*p.s.i.*	*percent*
Kraft (unbleached)	2200	1.33	17,140 ±1008	0.081	17,120 ± 676	0.077	27,400 ± 333	3.11 ±0.10	0.85 ±0.05	11,400 ± 740	0.58
Alpha	2200	1.35	17,100 ± 700	0.071	19,300 ± 775	0.088	25,540 ± 804	1.91 ±0.09	0.85 ±0.03	11,260 ±1243	0.43
Defibered rag	2200	1.35	17,000 ± 775	0.097	16,200 ± 533	0.093	26,400 ±1200	2.67 ±0.15	1.54 ±0.04	10,000 ± 320	0.66
Sulfite (unbleached)	2200	1.35	15,930 ± 252	0.067	15,260 ± 328	0.060	26,500 ±1300	2.69 ±0.32	0.78 ±0.04	9500 ± 480	0.69
Ground wood	2200	1.34	11,800 ± 220	0.055	10,820 ± 234	0.059	22,400 ±1243	1.21 ±0.07	0.55 ±0.04	8400 ± 809	0.43
Waste paper	2200	1.35	11,600 ±1732	0.044	12,320 ± 864	0.046	28,000 ± 943	1.54 ±0.09	0.61 ±0.21	8100 ± 807	0.55
Asbestos-glass fiber (85:15)	2200	1.72	17,700 ± 525	0.050	17,970 ±1155	0.050	27,000 ± 640	2.94 ±0.19	2.10 ±0.05	9,300 0 ± 1400	0.14

[a] Broken parallel to molding pressure.
[b] Notch runs parallel to molding pressure.

the corresponding strength values. The impact values recorded represent the average of at least eight and in some cases as many as twelve individual observations. The tensile strengths and compressive strengths reported are based on a minimum of seven individual samples. The flexural values represent at least six individual specimens and in some cases as many as ten. The water absorption was calculated from three individual pieces. The tensile, flexural and impact specimens all broke with clean fracture lines, and the compressive samples showed clean 45° breaks.

Experimental results

Effect of fiber type—Data illustrating the effect of the type of fiber upon the physical strength properties of the molded preforms are shown in Table II. The strength properties indicate a decided dependency upon fiber length, as shown by the low values which were obtained with ground wood and defibered waste paper as fillers. It is realized that the fibers were from different sources, and that the differences in the properties might be due to other causes such as previous history, pulping conditions, etc.; but it is felt that the main factor influencing the differences with the cellulosic fibers is their length. Increase in length after a certain maximum value has been reached, however, does not appear to control the strength, because the rag fiber, which was much longer than the others studied, did not show exceptionally high values. The average fiber lengths of the materials were determined according to the methods of Graff[7] and are listed in Table III.

The impact strength is apparently the most sensitive to fiber type, and with the strongest and least degraded fibers, i.e., kraft and sulfite, the highest values are obtained. The highly bleached fiber, alpha, has normal properties in other respects, but apparently the extensively degrading conditions of pulping and bleaching have removed practically all the lignin and broken down the cellulose so that the impact strength is about 33 percent less than that of the other fibers of equivalent length. The rag fiber, although extensively bleached, was not subjected to the extreme acid or alkaline cooking conditions and high temperatures which the wood fibers must undergo during the pulping process and, therefore, retains most of its strength.

In general, the properties obtained are quite high and better than those of most phenolic molding materials. The tensile strengths of molded kraft pulp-phenolic resin preforms are 100 percent better than those obtained with high-impact cellulose-filled molding powders and 33 percent better than general-purpose molding materials. The flexural strengths are about 60 percent higher than those of general-purpose molding materials. The water absorption is equivalent to that obtained with general-purpose molding powders, and 100 to 200 percent better than that of the high-impact-type materials. The impact strength is 20 to 35 times better than that of general-purpose molding powders and equivalent to that of the high-impact-type rag-filled materials.

[7] J. H. Graff and R. W. Miller, "Fiber Dimensions," Tech. Association Papers XXII, No. 1, 445–51 (1939).

TABLE III.—AVERAGE DIMENSIONS OF FIBERS USED IN PREFORMING STUDIES

Fiber	*Type*	*Fiber length*	*Fiber width*
		mm.	*mm.*
Kraft	Unbleached	3.42	0.035
Sulfite	Unbleached	3.21	0.034
Alpha	Bleached	3.43	0.036
Ground wood	Unbleached	1.58	0.034
Waste paper	Unbleached	1.89	0.054
Lignin enriched filler	.....	1.44	0.037
Rag (cotton)	Bleached	4.60	0.018
Asbestos	Mineral fiber	3.21	...
Glass	Inorganic fiber	30.10	...

Data previously reported by Haslanger and Mosher[4] has shown the effect of resin content on the physical properties. The tensile and flexural strengths showed a slight increase with increasing resin content, but the impact strength drops off rapidly. These data indicated a resin content of 35 percent as giving the optimum physical strength properties in the molded piece.

Effect of resin type—Table IV shows the effect of using resins of increasing molecular size on the physical properties of the molded preform. Before discussing the trends, however, it would be well to review the properties generally imparted by the different resin types. It is a commonly known fact that as the resin molecules increase in size and complexity, they go through a number of solubility ranges. The first condensation products are small molecules and these are completely water and alcohol soluble. As they increase in size, they become water insoluble, but are still alcohol soluble. Upon further condensation, the molecules become completely alcohol insoluble and go into what is known as the "cured" or "C" state. It is natural from this to say that the water-soluble molecules are small and would

TABLE IV.—EFFECT OF RESIN TYPE ON THE PHYSICAL PROPERTIES OF PREFORMED UNBLEACHED KRAFT FIBER CONTAINING 45 PERCENT RESIN

Resin type	*Molding pressure*	*Specific gravity*	*Flexural properties*				*Compressive strength edgewise*	*Impact strength (notched Izod)*		*Tensile strength*	*Water absorption*
			Parallel[b]		*Perpendicular*						
			Flexural strength	*Deflection*	*Flexural strength*	*Deflection*		*Perpendicular*	*Parallel*[c]		
	p.s.i.		*p.s.i.*	*in.*	*p.s.i.*	*in.*	*p.s.i.*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*p.s.i.*	*percent*
Brittle Resinox[a]	2200	1.33	17,140 ±1008	0.081	17,120 ±676	0.077	27,400 ±333	3.11 ±0.10	0.85 ±0.05	11,400 ±740	0.58
Alcohol-soluble Resinox[a]	4400	....	16,840 ±880	0.070	18,200 ±710	0.073	...	2.72 ±1.06	0.65 ±0.11	12,700 ±1070	0.54
Water-soluble Resinox[a]	4400	1.39	15,900 ±250	0.060	15,075 ±750	0.066	33,700 ±400	1.92 ±0.09	0.77 ±0.13	10,920 ±1144	0.40

[a] Monsanto phenolic resin, Monsanto Chemical Co.
[b] Broken parallel to molding pressure.
[c] Notch runs parallel to molding pressure.

easily impregnate the fibers, and that the larger molecules would be unable to penetrate the fiber structure and should remain on the surface.

In actuality, however, the solvent is an important factor in the impregnation, as is shown in Table V. Here a spray-dried water-soluble phenolic resin was dissolved in both water and in alcohol and used as an impregnating resin in both solutions. The results show that, although the molecular size of the resin must be important, the polarity of the solvent is also to be recognized. Water which is a highly polar solvent, penetrates into the fibers, forcing the chain molecules apart and thus allowing for the carrying of the resin molecules into the very center of the fibers. The less polar alcohol, since it is unable to swell the fibers, can only carry the resin into the preform and coat the individual fibers on their external surfaces. Thus in the case of the water solution, the resin is distributed throughout the preform and the molded piece is dimensionally very stable, has low water absorption, and low impact strength. The alcohol solution of the resins, on the other hand, gives a piece which has higher water absorption, poorer dimensional stability, and higher impact strength because the fibrous centers are not impregnated and, although vulnerable to moisture pickup, act as energy absorbers to increase the impact strength.

The flexural and tensile strengths drop off very slightly with decrease in the molecular size of the impregnating resin. The impact strength drops off rather sharply as the resin molecules in the impregnating solution decrease in size, and this is probably caused by the increasing degree of penetration by the resin and resulting embrittlement of the fiber. The deflection in flexure also shows a decrease with decrease in the size of the resin molecules in the impregnating bath—showing that the molded material becomes stiffer. The edgewise compressive strength tends to increase with decrease in the molecular size of the resin-fiber structure produced. The water absorption would be expected to decrease with decrease in the size of the impregnating resin molecules because of better fiber coverage and resin distribution.

The over-all picture shows very small variation in physical strength properties with change in resin type, except in impact strength and water absorption. Here there does seem to be a definite indication that, over the range studied, the larger the molecular size of the resin, the higher the impact strength and water absorption of the molded piece.

Effect of dispersing the resin in the beater—The effect of using beater-dispersed resin instead of adding it by impregnation methods is shown in Table VI. The physical strength values are all surprisingly high. Depending upon the resin used, the tensile strength was 50 percent higher and the flexural strength 20 to 50 percent higher than those obtained with the impregnated preforms. The edgewise compressive strength, however, was about 25 percent less and the impact strength about 25 percent higher than with impregnated preforms. The deflection in flexure showed the material to be very flexible and non-brittle. The water absorption was about two and one-half to three times that obtained on the impregnated stock.

In general it can be said that there is no significant increase in physical properties with a 100 percent increase in molding pressure, but the surface appearance of the molding is definitely improved.

When preparing performs by beater dispersion, the resin is distributed uniformly over the surfaces of the fibers in the form of discrete particles, and very little, except for water-soluble portions, enters the physical structure of the individual fibers. When the preform is molded, therefore, this resin tends to flux down and flow over these same surfaces and to some extent into the interior of the fiber under the pressures applied. The piece obtained is thus composed of innumerable fiber cores, bound together by layers of resin.

Strains will be uniformly transmitted throughout this structure in flexural and tensile testing. When the piece is stressed in compression, however, there is a tendency for the

TABLE V.—EFFECT OF SOLVENT TYPE ON THE PHYSICAL STRENGTH PROPERTIES OF MOLDED FIBER-RESIN PREFORMS

Solvent used in preparing preform	*Water absorption*	*Dimensional[a] stability*	*Impact strength[b]*
	percent	*percent*	*ft.-lb./in. of notch*
Water	0.9	4.7	1.01
Alcohol	2.4	14.2	2.09

[a] Percent increase in thickness after 48-hr. immersion in water at 25° C.
[b] Notch cut perpendicular to molding pressure.

TABLE VI.—PHYSICAL PROPERTIES OF PREFORMED KRAFT FIBER CONTAINING 45 PERCENT OF BEATER-DISPERSED PHENOLIC RESIN

Resin type	*Molding pressure*	*Specific gravity*	*Flexural properties* Parallel[a] *Flexural strength*	*Flexural properties* Parallel[a] *Deflection*	*Flexural properties* Perpendicular *Flexural strength*	*Flexural properties* Perpendicular *Deflection*	*Compressive strength, edgewise*	*Impact strength (notched Izod)* *Perpendicular*	*Impact strength (notched Izod)* *Parallel[b]*	*Tensile strength*	*Water absorption*
	p.s.i.		*p.s.i.*	*in.*	*p.s.i.*	*in.*	*p.s.i.*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*p.s.i.*	*percent*
Resinox L-7780	2200	1.36	27,400 ±400	0.188	24,400 ±1000	0.143	21,520 ±221	4.33 ±0.44	0.82 ±0.05	16,900 ±980	1.44
Resinox L-7780	4400	1.38	25,430 ±434	0.158	24,500 ±650	0.156	21,140 ±172	3.66 ±0.37	0.73 ±0.03	16,000 ±860	1.30
Resinox L-7832	2200	1.36	20,000 ±766	0.125	21,900 ±400	0.120	20,970 ±220	4.16 ±0.53	0.86 ±0.01	16,700 ±680	2.08
Resinox L-7832	4400	1.38	19,630 ±2700	0.131	20,900 ±550	0.140	20,840 ±192	4.06 ±0.51	0.89 ±0.01	16,800 ±1860	2.15
Resinox 49442	2200	1.36	28,000 ±450	0.201	29,940 ±1233	0.180	22,400 ±80	5.07 ±0.41	0.91 ±0.13	19,200 ±1034	2.21
Resinox 49442	4400	1.39	26,900 ±2870	0.170	26,730 ±848	0.156	21,984 ±217	4.07 ±0.38	0.92 ±0.05	19,400 ±1530	2.27

[a] Broken parallel to molding pressure.
[b] Notch runs parallel to molding pressure.

TABLE VII.—PHYSICAL STRENGTH PROPERTIES OF FIBER PREFORMED MATERIALS IMPREGNATED WITH AN 80-20 MELAMINE-PHENOLIC RESIN MIXTURE

Preformed ber type	*Resin content*	*Molding pressure*	*Specific gravity*	*Flexural properties* — *Parallel*[a] *Flexural strength*	*Parallel*[a] *Deflection*	*Perpendicular Flexural strength*	*Perpendicular Deflection*	*Compressive strength, edgewise*	*Impact strength (notched Izod)* *Perpendicular*	*Parallel*[b]	*Tensile strength*	*Water absorption*
	percent	*p.s.i.*		*p.s.i.*	*in.*	*p.s.i.*	*in.*	*p.s.i.*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*p.s.i.*	*percent*
Alpha	45	6600	1.43	14,600 ±1720	0.057	...	...	20,200 ±1040	2.48 ±0.82	0.58 ±0.08	7400 ±420	0.60
Rag	55	6600	1.43	13,000 ±1114	0.054	...	...	...	2.17 ±0.78	0.64 ±0.04	7500 ±564	0.61
Sulfite	45	6600	1.43	...	...	13,700 ±650	0.049	19,000 ±2500	2.75 ±0.36	0.85 ±0.05	5000 ±590	0.82
Alpha - rag 50-50	45	6600	1.42	15,850 ±1700	0.053	...	...	18,600 ±1040	2.72 ±1.00	0.64 ±0.04	...	0.41
Alpha - tire cord, 50-50	45	6600	1.44	8200 ±810	0.048	...	...	...	2.71 ±0.73	1.63 ±0.31	3300 ±396	0.60
Rag - tire cord, 50-5	55	6600	1.44	8740 ±713	0.050	...	...	...	...	1.90 ±0.63	...	0.51

[a] Broken parallel to molding pressure.
[b] Notch runs parallel to molding pressure.

piece to fail along the major axis of shear and the fiber resin bonds will break under a lower stress in this manner. The water absorption in this system will tend to be high, because wherever there is a fissure or break in the continuity of the resin film there will be a potential entrance for the water to the non-resinous hydrophilic fiber centers. The impact strength will be high, because the fibrous centers will absorb the applied energy. The structure will be flexible and give a high deflection in flexure for the same reason.

At any given resin content, however, the molding pressures required to obtain equivalent flow in a beater-dispersed resin-fiber preform are three to four times as high as those required for an impregnated resin-fiber preform.[8] This has been explained in the following manner: Impregnated preforms are composed of fibers which are probably entirely coated with a thin film of resin. This film softens upon the application of heat and pressure and acts as a lubricant for the flow and compression of the fibers to the ultimate density. On the other hand, the resin in the preforms prepared by beater-dispersion techniques is distributed over the fiber surfaces in discrete particles. When heat and pressure are applied to the preform, the dry fibers take up the applied force until the structure is compressed sufficiently to flux out the resin. Only after this takes place can the resin plasticize the further compression and packing of the fibrous structure.

Properties of melamine-phenolic resin preforms—Data showing the physical properties that can be expected with molded melamine-phenolic resin-fiber preforms are presented in Table VII. A combination of phenolic resin with the melamine was used to reduce the brittleness of the resin. The solvent used for impregnation was an alcohol-water mixture.

The flexural strengths were found to be about 80 percent of the values obtained with phenolic resins at the same resin content and using similar fiber bases. The tensile strengths were about 50 to 70 percent of the values obtained with phenolics, and the compressive strengths showed similar values. The deflections in flexure, however, were low and showed the material to be very brittle. The water absorptions were about equivalent to those obtained with the phenolic molded materials. The impact strengths were remarkably high, considering the other properties obtained, and were about equivalent to those obtained with the molded phenolic impregnated preforms.

Melamine resins are very interesting to the molder because of their range of available colors and also because they produce a molded piece with superior electrical and arc-resistance properties and an extremely hard surface.

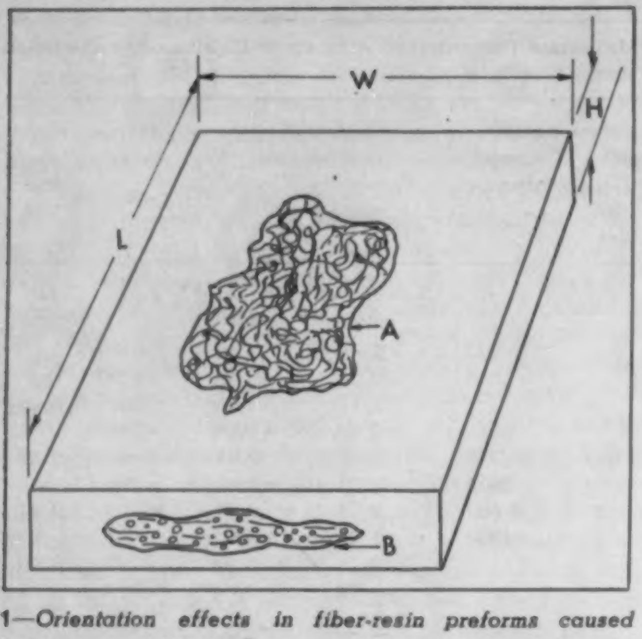
Effect of lignin-enriched filler (*L.E.F.*)—Data were collected on the effect of using a natural resin-containing fiber (L.E.F.) as the basic filler for the preform and the results are shown in Table VIII. Two different moisture contents were prepared because it has been reported that water acts as a plasticizer for the lignocellulosic material.[9] Complete data were not obtained on the pieces molded at 10 percent moisture content, because there did not appear to be any significant change in tensile strength over the pieces molded at 5 percent moisture. The properties obtained were in the range of standard molding powders and well below those obtained with any of the phenolic-fiber combinations except ground wood and waste paper. The water absorption was exceedingly high, about eight times that of the average impregnated phenolic-fiber combination.

By adding 20 percent of phenolic resin to the preformed L.E.F. by impregnation methods, the moldings lost their thermoplasticity and could be removed from the mold without cooling. There was also a definite increase in flow, thus allowing the use of lower molding pressures. The physical properties did not show any distinct changes in tensile or impact strengths, but did drop about 20 percent in flexural strength and increased in edgewise compressive strength by about the same amount.

The water absorption showed an interesting change. The preforms impregnated with a high molecular weight resin

[8] R. H. Mosher and J. B. Griffin, Unpublished data, Plastics Div., Monsanto Chemical Co.

[9] J. Meiler, "Method of Treating Lignocellulosic Material to Produce a Moldable Product," U. S. Patent 2,292,390.



1—Orientation effects in fiber-resin preforms caused by vacuum felting. A is a cross section of the top view of the preform, showing the random orientation of fibers in the L-W plane. B is a cross section of the end view of the preform, showing the layering effect which is caused by the vacuum-felting of the fibers

in an alcohol solution did not exhibit any variation from the straight L.E.F., but those which had been impregnated with a low molecular weight resin in water as a solvent showed a 75 percent decrease in water pickup. This follows directly from the results reported in Table V for alcohol and water solutions of resins.

Anisotropy of preformed fiber-resin materials

A reference should be made to the anisotropy of the fiber-resin preformed materials. It can be seen from Table II that the impact strength is much higher when the bar is broken with the notch running perpendicular to the molding pressure than when it is running parallel. In the first case the blow is delivered on the top of the bar and each of the individual fibers as well as the resin layers bonding them together must be broken. In the second case, the blow is delivered on the edge of the piece, and the brittle resin layers can be easily sheared. Such a directional strength is inherent in this material because of the way that fibers are laid down during the felting operation. It is exhibited only in the impact test, however, because of the excellence of the resin to fiber bond. The randomness of the fiber orientation on the *L-W* plane (Fig. 1) gives equal tensile strength in all directions. The same is also true of the flexural and compressive strengths. The piece should have equivalent strengths in all directions on the *L* and *W* plane, and in this respect has a great advantage over laminates which, even though cross laminated and equivalent in strength at right angles, are weak in a direction 45° from the major axes.

Conclusions

1. The physical strength properties of a molded fiber-resin preformed material are primarily dependent upon the type of fiber which is used to prepare the preform. The properties are also dependent upon the type of resin and the method of resin incorporation.

2. In the range of cellulosic fibers examined, the optimum values for each property can be obtained in the following manner:

Impact strength	Beater-dispersed resin
Flexural strength	Beater-dispersed resin
Deflection (max.)	Beater-dispersed resin
Edgewise compressive strength	Impregnation with water-soluble resin
Water absorption	Impregnation with water-soluble resin
Tensile strength	Beater-dispersed resin

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TABLE VIII.—PHYSICAL PROPERTIES OF PREFORMED "LIGNIN ENRICHED FILLER" MATERIALS

Preformed fiber type	*Added resin*	*Molding pressure*	*Specific gravity*	*Flexural properties: Parallel[a] Flexural strength*	*Flexural properties: Parallel[a] Deflection*	*Flexural properties: Perpendicular Flexural strength*	*Flexural properties: Perpendicular Deflection*	*Compressive strength, edgewise*	*Impact strength (notched Izod) Perpendicular*	*Impact strength (notched Izod) Parallel[b]*	*Tensile strength*	*Water absorption*
		p.s.i.		*p.s.i.*	*in.*	*p.s.i.*	*in.*	*p.s.i.*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*p.s.i.*	*percent*
L.E.F., 5 percent moisture	None	6600	1.43	11,420 ±172	0.044	11,300 ±592	0.042	16,840 ± 348	1.45 ±0.16	0.70 ±0.07	7200 ± 279	4.09
L.E.F., 10 percent moisture	None	6600	1.43	...	...	...	...	...	...	...	6900 ± 346	4.50
L.E.F.	20 percent alcohol-soluble Resinox[c]	4400	1.40	...	...	9000 ±200	0.032	...	1.37 ±0.26	0.69 ±0.05	8000 ±320	4.08
L.E.F.	20 percent water-soluble Resinox	4400	1.42	8200 ±325	0.030	8470 ±490	0.034	20,530 ±1001	1.39 ±0.12	0.57 ±0.05	7200 ±116	0.78

[a] Broken parallel to molding pressure.
[b] Notch runs parallel to molding pressure.
[c] Phenolic resin, Monsanto Chemical Co.

Unnotched impact strength of allyl resins by the falling-weight-method*

by MAURICE E. MARKS**

IN present-day plastic testing it has been the practice to determine impact strength on standard size bars and to report the results on a total energy absorbed basis per unit thickness. Since occasions frequently arise where it is desired to compare samples of different thicknesses, lengths and widths, it was thought advisable to investigate this matter in some detail.

The pendulum method was discarded for this investigation because its use leads to certain inherent errors such as the loss of energy necessary to throw the sample from the platen after it has broken, and the energy required to propagate the crack across the sample. It is also difficult to change the velocity and load of the pendulum. The falling weight method, while more inconvenient and time consuming, does allow the velocity to be varied at will, and also facilitates the easy variation of the load which may be applied to the specimen.

Experimental equipment and procedure

The falling-weight apparatus used in this work was similar to that designed by Callendar.[1] A weight with a 1/8-in. radius striking head fell between guides fastened to a sturdy welded steel frame over a total distance of 30 inches. The specimens rested on anvils of 1/8-in. radius, adjustable in span length from 1 1/2 to 12 in. and up to 1 in. in width. Weights of from 0.1 to 1 lb. were provided.

Unnotched specimens were placed on the anvils at the desired span length and a suitable weight was dropped from a 12-in. height. If the sample did not break, the distance was increased to 18 in. and again dropped. If a break did not then occur, the procedure was repeated with a heavier weight until the sample broke. Another specimen was then placed on the anvil and the procedure repeated with the last weight used at a lower height. This weight was raised by 1/4-in. distances until the second sample broke. It was then found possible to break the remaining samples with only a few blows. About ten specimens were used for each test.

For the data given in this paper, experimental allyl resins were used for most of the tests. Span lengths from 1.5 to 10 in., widths from 0.1 to 1 in., and depths from 0.1 to 0.5 in. were tested. All samples were tested as unnotched Charpy specimens, i.e., as a simple beam with two points of support and struck in the center.

Results of impact tests

In Table II (appearing on the following page) are given the data obtained on cast Allymer C.R. 39 with the falling-weight apparatus. A series of 78 tests were made on groups of ten specimens each or a total of 780 breaks. It was found that the error in the determination varied with different size samples but averaged about 8 percent mean deviation.

It can be shown that in impact the following equation is valid[2]:

$$W = \frac{\rho_m^2}{18E} V\left(l + \frac{6}{5}\frac{E}{G}\frac{d^2}{l^2}\right) \qquad \text{(Equation 1)}$$

where:

ρ_m = maximum stress
E = modulus of elasticity
G = modulus of shear
V = volume of specimen
d = depth of specimen
l = length of specimen between anvils

This equation specifies the load necessary to obtain the stress ρ_m over the entire dimensional range of specimens, since both the bending stress and the shear stress are considered in the derivation. In short, thick samples the shear component is prominent and is corrected by the second term of the equation, while in long, thin samples the bending force is prominent and is taken care of by the first term of the equation. (*Please turn to next page for Table II and page 188 for continuation of text*)

* Based on a report presented at the meeting of Subcommittee VIII on Research, A.S.T.M. Committee D-20 on Plastics, in New York, N. Y., June 1944.

** Columbia Chemical Div., Pittsburgh Plate Glass Co.

[1] British Plastic *13*, 456 (1942).

[2] Timoshenko, "Strength of Materials," Vol. I, pp. 170, 300, New York: D. Van Nostrand Co.

TABLE I.—IMPACT STRENGTH OF CAST RESINS DETERMINED EXPERIMENTALLY AND CALCULATED FROM FLEXURAL DATA

Material	*Width (b)*	*Depth (d)*	*Length of span (l)*	*Impact Strength*		*Difference*	
				From flexural test	*From impact test*		
	in.	*in.*	*in.*	*in.-lb.*	*in.-lb.*	*in.-lb.*	*percent*
Cast Allymer	0.504	0.141	3	3.1	2.9	0.2	6.9
C.R. 39	0.507	0.245	5	13.2	11.2	2.0	17.9
Cast Allymer C.R. 38	0.503	0.261	5	9.1	8.8	0.3	3.4
Cast Allymer C.R. 149	0.503	0.260	5	27.4	22.7	4.7	20.7
Methacrylate	0.504	0.117	3	3.1	5.5	1.4	25.5
	0.503	0.259	5	14.3	22.8	8.5	37.2
Cellulose acetate	0.503	0.126	3	1.7	16.3	14.6	89.6

Table II.—Falling-Weight Impact Strength of Cast Allymer C.R. 39[a]

Dimensions of sample			*Impact strength by experiment*			*Impact strength calculated from Equation (3)*		
			W_e	*Average deviation from mean*		W_c	*Average deviation from mean of* W_e	
b *in.*	*d* *in.*	*l* *in.*	*in.-lb.*	*in.-lb.*	*percent*	*in.-lb.*	*in.-lb.*	*percent*
0.500	0.070	1.5	0.7	0.1	14.3	0.7	0.0	0.0
0.243	0.097	2.0	0.9	0.0	0.0	0.6	−0.3	33.3
0.500	0.065	1.5	0.5	0.1	20.0	0.7	+0.2	40.0
0.500	0.070	2.0	0.9	0.1	11.1	0.9	0.0	0.0
0.500	0.065	2.0	0.7	0.1	14.3	0.9	+0.2	28.6
0.500	0.122	1.5	1.7	0.1	5.9	1.3	−0.4	23 5
0.248	0.093	4.0	1.5	0.1	6.7	1.2	−0.3	20.0
0.500	0.133	1.5	1.3	0.1	7.7	1.4	+0.1	7.7
0.500	0.065	3.0	1.1	0.2	18.2	1.3	+0.2	18.2
0.500	0.070	3.0	1.4	0.2	7.7	1.4	0.0	0.0
0.504	0.105	2.0	2.0	0.1	5.0	1.5	−0.5	25.0
0.500	0.122	2.0	1.4	0.3	21.4	1.6	+0.2	14.3
0.500	0.133	2.0	1.5	0.2	13.3	1.8	+0.3	20.0
0.500	0.065	4.0	1.2	0.2	15.4	1.7	+0.5	41.7
0.500	0.070	4.0	1.3	0.1	7.7	1.8	+0.5	38.5
0.250	0.094	6.0	2.3	0.1	4.3	1.8	−0.5	21.7
0.259	0.260	2.0	2.4	0.1	4.2	2.3	−0.1	4.2
0.500	0.122	3.0	2.1	0.3	14.3	3.0	+0.9	42.9
0.500	0.257	1.5	2.8	0.2	9.3	3.6	+0.8	28.6
0.500	0.255	1.5	3.4	0.3	8.8	3.6	+0.2	5.9
0.250	0.102	8.0	3.9	0.3	7.9	2.5	−1.4	35.9
0.254	0.392	2.0	5.0	1.0	20.0	4.3	−0.7	14.0
0.500	0.133	3.0	2.0	0.2	10.0	2.7	+0.7	35.0
0.505	0.100	4.0	3.0	0.3	7.7	2.6	+0.4	13.3
0.500	0.122	4.0	3.0	0.5	16.7	3.0	0.0	0.0
0.102	0.115	2.0	3.0	0.4	13.3	3.1	+0.1	3.3
0.753	0.150	2.0	5.8	0.5	8.6	3.2	−2.6	44.8
0.502	0.250	2.0	7.3	0.3	4.1	4.1	−3.2	43.8
0.500	0.257	2.0	4.3	0.2	6.3	4.3	+1.0	31.3
0.500	0.255	2.0	4.2	0.4	9.5	4.2	0.0	0.0
0.500	0.133	4.0	3.5	0.2	7.2	3.5	+0.9	34.6
0.253	0.264	4.0	4.3	0.2	4.7	7.2	+2.9	67.4
0.500	0.375	1.5	4.8	0.1	2.1	7.5	+2.7	56.3
0.500	0.378	1.5	6.0	0.8	13.3	7.5	+1.5	20.0
0.505	0.384	2.0	7.0	1.6	22.8	6.1	−0.9	12.9
0.500	0.375	2.0	5.9	0.2	3.3	7.8	+1.9	32.2
0.500	0.255	3.0	4.2	0.4	9.5	5.4	+1.2	28.6
0.500	0.378	2.0	5.9	0.2	3.4	5.1	−0.8	13.6
0.500	0.257	3.0	4.6	0.1	2.2	5.6	+1.0	21.7
0.505	0.384	2.0	7.0	1.2	13.8	5.3	−1.7	24.3
0.258	0.264	6.0	6.4	0.2	3.1	5.4	−1.0	15.6
0.751	0.146	4.0	6.6	0.6	9.0	6.2	−0.4	6.1
0.954	0.254	2.0	6.3	0.3	4.8	8.0	+1.7	27.0
0.500	0.255	4.0	6.6	0.6	9.1	6.9	+0.3	4.5
0.503	0.253	4.0	13.8	0.5	3.6	6.9	−6.9	50.0
0.500	0.505	2.0	16.7	0.9	5.4	13.7	−3.0	18.0
0.500	0.257	4.0	5.7	0.4	7.1	7.1	+1.4	24.6
0.258	0.264	8.0	6.3	0.7	11.1	7.1	+0.8	12.7
0.500	0.375	3.0	10.0	1.7	17.0	9.1	−0.9	9.0
0.500	0.378	3.0	7.7	0.5	6.5	9.3	+1.6	20.8
0.500	0.378	3.0	7.3	0.1	1.4	9.3	+1.6	21.9
0.252	0.383	6.0	9.9	0.6	6.1	7.9	−2.0	20.2
0.732	0.405	2.0	12.4	1.2	9.7	12.9	+0.5	4.0
0.996	0.104	6.0	8.2	0.5	6.1	7.9	−0.3	3.7
1.430	0.111	4.0	6.2	0.4	6.5	8.1	+1.9	30.6
0.257	0.260	10.0	8.1	0.7	8.7	8.6	+0.5	6.2
0.500	0.375	4.0	9.5	1.0	9.6	11.0	+1.5	15.8
0.500	0.506	3.0	9.9	0.9	9.1	14.5	+4.6	46.5
0.500	0.378	4.0	8.0	0.7	8.8	11.2	+3.2	40.0
0.756	0.505	2.0	18.9	0.6	3.2	20.5	+1.6	8.4
0.503	0.384	4.0	7.1	0.2	2.8	11.4	+4.3	60.6
0.502	0.255	6.0	14.9	0.6	4.0	10.1	−4.8	32.2
0.253	0.386	8.0	13.0	1.2	9.2	10.3	−2.7	20.8
0.749	0.149	8.0	16.3	1.7	10.4	11.4	−4.9	30.1
1.000	0.113	8.0	12.8	1.3	10.2	11.5	−1.3	10.2
0.254	0.383	10.0	15.0	3.0	19.0	12.7	−2.3	15.3
0.970	0.254	4.0	18.7	0.7	3.7	13.5	−5.2	27.8
0.500	0.506	4.0	10.1	0.4	4.0	16.5	+6.4	63.4
0.502	0.254	8.0	21.8	1.4	6.4	13.2	−8.6	39.4
0.505	0.506	4.0	16.8	1.2	7.2	16.6	−0.2	1.2
0.748	0.146	10.0	16.3	1.6	9.8	14.0	−2.3	14.1
0.503	0.383	6.0	12.3	0.8	6.5	15.8	+3.5	28.5
1.000	0.116	10.0	12.7	0.8	6.3	14.8	+2.1	16.5
0.754	0.406	4.0	19.5	1.2	6.2	18.3	−1.2	6.2
0.494	0.253	10.0	12.0	1.3	10.8	16.1	+4.9	34.2
0.988	0.252	6.8	22.7	0.3	1.3	19.5	−3.2	14.1
0.501	0.386	8.0	21.0	2.0	9.4	20.5	−0.5	2.4
0.504	0.381	10.0	22.0	1.6	7.3	24.8	+2.8	12.7
			[a] Over-all average		8.5	Over-all average		22.6

TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

LAMINATING LUMBER FOR EXTREME SERVICE CONDITIONS. C. D. Dosker and A. C. Knauss. Mechanical Eng. *66,* 763–73 (Dec. 1944). A new type of laminated timber product capable of giving satisfactory glue-joint performance under extreme conditions of exposure was developed as a result of the critical wartime need for timbers for boat and shipbuilding. Such laminated timbers can be expected to be as resistant to decay, insects and fire as solid timbers of the same kind of wood. A technique for laminating timbers with low-temperature-setting phenol-, melamine-, and resorcinol-resin glues was developed and has been used successfully in the fabrication of white-oak ship timbers. These glues have demonstrated in laboratory tests that, when properly cured, they are highly resistant to both fresh and salt water and there has been no report of glue-line failure in service in any of the laminated products produced in accordance with this technique. Recommended curing schedules were developed for laminating Douglas-fir and shortleaf-pine timbers with the same types of glue for equally severe exposure. Although most of the production to date by these methods has been concerned with such items as boat keels, frames, stems, skegs and planking, the postwar prospects of producing laminated timbers with durable glue joints, according to this process, for exterior and interior marine use appear promising. Some typical laminated products that have been made for use under severe exposure conditions include a 1-piece white-oak stem and keel for a 50-foot motor launch and a set of 14-foot railroad bridge stringers constructed of Southern yellow pine.

GLUING PLYWOOD. N. A. De Bruyne. British Plastics *16,* 446–8 (Oct. 1944). It is difficult to obtain good bonds with 30 percent of all aircraft plywood. Plywood which has this undesirable characteristic is called "case hardened" plywood. An investigation has revealed that the poor joints are caused by a damaged surface on the plywood. The damaged surface gives poor bonds because: 1) it is mechanically weak, 2) it impedes the elimination of water from the glue, and 3) it prevents access of the glue to the inner surface of the cell walls. Thus, the reason for the trouble is a mechanical one and not a chemical one. The fault is remedied by removing the damaged surface either by sanding or by shot blasting.

STRENGTH OF GLUED SHEET METAL. N. A. De Bruyne. Iron Age *154,* 60–3 (Aug. 24, 1944). Reprinted from Aircraft Engineering *16,* 115–18 (Apr. 1944). The strains developed in glued lap joints when stresses are applied are discussed. The beveled-lap joint has breaking strengths nearly those expected, whereas plain-lap joints give much lower values. Results obtained with sheet metals bonded with a synthetic resin adhesive, Redux, are reported.

SPOT GLUING. British Plastics *16,* 453–4 (Oct. 1944). A high-frequency heating gun for spot gluing with synthetic resin adhesives is described.

HIGH-FREQUENCY HEATING. R. R. Baker and C. J. Madsen. Paper Trade J. *119,* 25–30 (Aug. 24, 1944). Inductive and dielectric heating are defined and a short discussion of the inductive process is presented. The principles of dielectric heating are discussed and the basic equations for the determination of the varied factors required for a particular application are given. The loss factors and specific heat are listed for a number of materials. The spacing of the electrodes is given consideration. The use of dielectric heating is of particular value in the processing of thick sections, but the economic aspects must not be neglected in determining its application. Examples are given which indicate the possibilities and limitations of this type of heating in the paper as well as paperboard industry.

NEW STANDARDS FOR LAMINATED PLASTICS. W. Krassowsky. Kunststoffe *33,* 78–9 (1943); Chem. Abstracts *38,* 5022 (Sept. 20, 1944). This specification for formed laminated plastics, VDEO320, covers definitions, designations, properties, test methods and ratings.

Chemistry

VISCOSITY AND CHEMICAL CONSTITUTION OF MACROMOLECULAR SYSTEMS. H. Umstätter. Kolloid-Z. *103,* 7–18 (1943). A viscosity-concentration function is derived which shows that the shearing elasticity of high polymers dissolved in solvents changes with the concentration and in proportion to the intrinsic viscosity. The molecules of high polymers are not rigid and this renders the determination of molecular weights by kinetic means difficult. The particle size of high polymers with the attached solvent molecules can be determined from the viscosity curves. There is a lower limit to the mechanical stability of these particles. The molecular weights of some naturally-occurring materials determined by viscosity measurements are not true because the size of the particles measured are accidental.

POLYMERIZATION OF INDENE AND ITS ACCELERATION BY PEROXIDES. J. W. Breitenbach and G. Bremer. Berichte *76B,* 1124–9 (1943); Chem. Abstracts *38,* 4933–5 (Sept. 10, 1944). The polymerization of indene by heat and by benzoyl peroxide was studied. The heat polymerization of indene differs from that of styrene in that it proceeds very slowly and results in a very low molecular weight (400) product whose average molecular weight does not depend on the polymerization temperature. In the peroxide polymerization, there is a close correlation between the polymerization of indene and that of styrene; the only difference is that the growth reaction of indene is slower than styrene.

A METHOD OF NUCLEAR METHYLATION OF PHENOLIC SUBSTANCES. M. G. Barclay, A. Burawoy and G. H. Thomson. J. Chem. Soc. *1944,* 400–4 (Aug. 1944). A method of nuclear methylation of phenolic substances is described. *o-* or *p*-hydroxyaryl alcohols and -hydroxyarylamines form, when heated above 250°C., anhydrohydroxyaryl alcohols, which, analogously to the anhydro-4-aminoaryl alcohols, spontaneously undergo two reactions: 1) Disproportionation with formation of methylated phenols and unidentified oxidized resins serving as a source of hydrogen. 2) Condensation to substances containing two or more phenolic groups connected by methylene linkages, such as the crystalline dihydroxydiarylmethanes or the complicated high-molecular phenol-formaldehyde resins, which subsequently decompose with the formation mainly of the original phenols. The second reaction is prevented to a varying degree when the heating is carried out in the presence of suitable alkalis. This investigation throws new light on the nature and formation of phenol-formaldehyde resins: 1) It confirms the generally accepted view that these possess structures involving numerous phenolic groups connected by methylene linkages, since, like the crystalline

dihydroxydiarylmethanes, they decompose at high temperatures with formation mainly of the original phenols and only traces of methylated phenols. 2) It shows that their formation can be preceded not only by that of hydroxymethylphenols, but also that of anhydrohydroxymethylphenols, which are stable under certain conditions and, in contrast to the phenol-formaldehyde resins, decompose at high temperatures to form methylated phenols.

Properties

GAS PERMEABILITY OF COATED FABRICS. Technical News Bulletin of the National Bureau of Standards No. *328*, 57–8 (Aug. 1944). The activities of the National Bureau of Standards in testing the gas permeability of coated fabrics are described. Some of the results observed in these tests are as follows: 1) The permeabilities of most types of synthetic rubbers are lower than that of natural rubber. 2) The rate of gas permeation of neoprene is about one-fourth that of natural rubber. 3) The rate of permeation of GR-S is nearly the same as that of natural rubber. 4) The permeability of rubber to helium is about two-thirds of its permeability to hydrogen. 5) Carbon dioxide penetrates rubber at a rate 2.9 times that of hydrogen. 6) Rubbers of the butadiene-acrylic nitrile type have about the same rates for the three gases. 7) In the case of butyl rubber and the nonvulcanizable elastomer, polyisobutylene, the permeability of helium is slightly greater than to hydrogen and the rate of passage of carbon dioxide is slightly more than ⅓ that of hydrogen.

LOAD CHARACTERISTICS OF CELLULOSE ACETATE PLASTIC. W. N. Findley. Aviation *43*, 163–9, 263, 265, 269 (June); 164–5, 263–4 (July); 163–5, 260–4 (Aug. 1944). The properties of a sample of transparent cellulose acetate plastic were determined. These include tensile strength, compressive strength, torsion strength, and creep and fatigue properties. The effect of speed of testing, of moisture content, of range of stress in fatigue and of stress on creep in tension were also studied. The load-resisting characteristics of cellulose acetate are quite similar to those of metals, the differences being largely in magnitude. Certain factors which are unimportant in the testing or application of metals cannot be overlooked in plastics. For example, small changes in temperature, relative humidity and rate of strain produce marked changes in measured values of load-resisting characteristics of cellulose acetate. Yield point and fracture stress increase with increasing rate of strain for tests in tension, compression and torsion. Modulus of elasticity in tension and torsion is independent of rate of strain for values tested, but modulus in compression increases with increasing rate of strain for loading in compression. The following values of modulus were found: tension, 244,000 p.s.i.; torsion, 78,000 p.s.i.; compression varied from 204,000 to 278,000 p.s.i. At a tensile rate of strain of 0.04 per min., the values of upper yield point were: tension 4,400 p.s.i.; torsion 3,300 p.s.i.; compression (long specimen) 4,300 p.s.i. The fracture stress was: tension 5,500 p.s.i. and torsion (modulus of rupture) 4,900 p.s.i. Aging of material at constant temperature and relative humidity increases tensile strength about 4 to 12 per cent and modulus of elasticity in tension about 15 per cent during about one year. A transverse hole in a static tension specimen reduced ultimate elongation in 2 in. to about 8 percent of elongation in a solid specimen. Ultimate strength (based on net area) was about 10 percent less for a specimen with a hole than for solid specimens. Yield point and weight approach equilibrium in an atmosphere of constant temperature and relative humidity in 1½ months. Fatigue tests showed that the endurance limit, obtained by computing stress from the flexure formula, varied with the shape of the specimen. A 45 degree V-notch reduced the endurance limit 53 percent. Aging was found to increase the endurance limit about 25 percent in 15 months. The endurance limit was decreased by a rise in the temperature of the specimen from internal friction. Speed of testing affects the endurance limit. The endurance limit decreased with increasing testing frequency up to 750 cyc. per minute. From there on to 2,900 cyc. per min., the endurance limit was constant. A change in range of stress causes decrease in the endurance limit (in terms of alternating component of stress cycle), as mean stress of cycle becomes larger, for values of mean stress in tension. Two regions of constant creep were observed with an initial and an intermediate transition region of decreasing rate of creep. No final stage of rapidly increasing rate occurred, such as the "third stage" in metals. A critical stress value was observed above which relatively large creep occurred and below which relatively small creep occurred. Creep limit of material was found to be 1,000 p.s.i. (for 1 percent creep in 6,000 hr.) at 77°F. and 50 percent relative humidity. Ductility, as measured by percentage elongation at fracture, decreased with increasing time for fracture (or decreasing stress values). Aging caused a marked decrease in first-stage rate of creep.

THE RHEOMETRY OF ORGANIC GLASSES. W. Scheele. Kolloid-Z. *105*, 209–16 (1943); Chem. Abstracts *38*, 5024 (Sept. 20, 1944). The flow characteristics of plasticized and unplasticized polyvinyl acetate, polyisobutylene and polystyrene were determined with a Höppler consistometer. Ester-type plasticizers do not change the slope of the work-deformation curves of polyvinyl acetate but merely displace the curves. Hydrocarbon plasticizers cause a slight change in slope. The slope of the work-deformation curve for polystyrene is greater because of the lower mobility. The lower mobility is attributed to the presence of the benzene ring. Phthalate ester plasticizers cause the flow of polystyrene to be less sensitive to temperature changes; this is a result of changes in cohesive forces or increased mobility of the ring.

Testing

WATER-VAPOR PERMEABILITY OF SHEET MATERIALS AT HIGH TEMPERATURE AND HUMIDITY. Paper Trade J. *119*, 29–32 (July 27, 1944). TAPPI Tentative Standard Method of Test 464m-44 for determining the water-vapor permeability of sheet materials at 100° F. with a relative humidity of 90 percent on one face and less than 5 percent on the other is presented. Copies may be obtained from the Technical Association of the Pulp and Paper Industry, 122 E. 42nd Street, New York, N. Y., for 25 cents each.

DEEP-DRAWING TESTS FOR THE DETERMINATION OF THERMOPLASTICITY. A. Thum and H. Sigwart. Kunststoff-Tech. u. Kunststoff-Anwend. *13*, 72–6 (1943); Chem. Abstracts *38*, 5614 (Oct. 20, 1944). The molding characteristics of sheet methyl methacrylate plastic were determined by a deep-drawing technique. The sheet is clamped over a container filled with paraffin oil and a ball is pressed into the plastic until it breaks. The tests are made on a testing machine so that the depth of draw and the forces required to deform the plastic are measured. Tests may be made at various temperatures by controlling the temperature of the oil. The deep-drawing ability is expressed as the percentage ratio of the depth of draw to the diameter of the ball. Tests were made on sheets 2, 3, 4, 5 and 6 mm. thick and at temperatures of 90 to 150° C. The maximum deep-drawing ability of all thicknesses was attained at 110° C. The resistance to molding decreases 1) with a decrease in thickness and 2) with an increase in temperature.

A METHOD OF TESTING THE FLOW OF THERMOSETTING PLASTICS. E. A. Veillon. Schweiz. Arch. angew. Wiss. Tech. *9*, 184–5 (1943); Chem. Abstracts *38*, 5324 (Oct. 10, 1944). A recording manometer is built into the pressure line of a hydraulic press. The area under a time-pressure curve obtained during the molding of a beaker 10 cm. high is taken as the flow number. The more readily the composition flows, the smaller the flow number. The principle is the same as that of the Schwittmann method.

TESTING OF FILMS OF SYNTHETIC SUBSTANCES AT LOW TEMPERATURES. K. Wellinger and G. Stähli. Kunststoff-Tech. u. Kunststoff-Anwend. *33,* 103–4 (1943); Chem. Abstracts *38,* 5325 (Oct. 10, 1944). Thin films, 0.4 mm. thick, are subjected to bending tests at -40° C. at an angle of 135° about a 10-mm. mandrel under a tensile force of 12-kg./cm.² This test is used to evaluate the low temperature flexibility of thin films.

Synthetic rubber

EFFECT OF MOISTURE ON CURING RATE OF GR-S. H. A. Braendle and W. B. Wiegand, Ind. Eng. Chem. *36,* 724–7 (Aug. 1944). The moisture content of uncured GR–S compounds has an effect on curing rate. Excessively dry polymer (below about 0.15 percent water) is slow curing. Mixed stock with less than 0.5 percent water is slow curing and erratic in curing rate. Mixed stock which is dry and slow curing may be conditioned to stable curing rate by storage under humid conditions. A moisture content of 0.5 to 1.0 percent is satisfactory. This moisture content seems also to eliminate differences in curing rate between polymers. The normal moisture range of carbon black does not affect the curing rate of GR–S. Laboratory-scale tests on a GR–S tread compound indicate that an addition of about 2.5 to 5 percent water (on the polymer) during mixing will result in a mixed-stock moisture content giving minimal cure variation for normal-curing and slow-curing (very dry) polymers for periods of stock layover up to about 3 weeks. Any additions of water will, on the factory scale, require adjustment since moisture retention will be a function of the compounding ingredients, mixing cycle and temperature, storage time and humidity conditions.

POLYESTER-TYPE ELASTOMER FROM SMILAX ROTUNDIFOLIA SEEDS. A. R. Kemp and H. Peters. India Rubber World *110,* 639–41 (Sept. 1944). The elastic skin from the seeds of Smilax rotundifolia, Linn or Horse-Brier, which grows wild in Florida is described. Although the structure of the elastomer has not been probed, the chemical and x-ray data point toward a repeating unit having 17 or 18 carbon atoms in the chain with two hydroxyl side groups. Upon hydrolysis a hydroxy acid apparently is produced, the exact structure of which has not been determined. Although the composition of this substance points strongly toward its being a condensation product of a hydroxy acid, $C_{18}H_{34}O_{4}$, further work will be necessary to elucidate completely the exact polymeric structure of this substance. Whether cross-linking is present or the substance is simply an extremely high molecular weight polyester is unknown. The lack of solubility indicates the possibility of some cross-linking. Hydrogen bonding may play a part in the lack of solubility of this unique polyester.

USES OF RUBBER-DERIVATIVE RESINS. H. R. Thies. Modern Packaging *18,* 123–5, 156 (Oct. 1944). The applications of a cyclized thermoplastic rubber resin which is made by treating high-grade low-protein-content rubber with stannic chloride are described. The resins are used extensively in packaging applications. These resins are soluble in hydrocarbons, chlorinated hydrocarbons, terpenes and waxes. The films formed from the solutions are transparent, clear, glossy, non-tacky, and highly resistant to water, moisture vapor, acids and alkalis. The resins are used to coat papers, cardboard, glassine, transparent sheetings, labels, and metal foils to increase their moisture-vaporproofness and provide heat sealability. They are also used to strengthen, improve toughness, and reduce tendency to flake and crystallize of wax coatings.

GENERAL ASPECTS OF GR-S RUBBER SATURANTS. R. T. Nazzaro. Paper Trade J. *119,* 33–6 (Sept. 28, 1944). The relative value of synthetic rubbers in general for the treatment of paper is discussed. The composition, reactions and properties of rubber latex, GR-S latex, and polyvinyl acetate resin are given. The physical and chemical properties of GR-S latex make it a satisfactory substitute for the versatile natural rubber latex in the impregnation of paper. The better properties of GR-S latex can be stated as follows: 1) It has good film-forming properties and high elongation; 2) it has good color; 3) the paper fibers appear to be satisfactorily bound; 4) it can be stabilized for use commercially by known materials; 5) residual odor is not objectionable; 6) saturated papers retain their flexibility over a longer period of time compared to most vinyl acetate plasticized resins, and, if suitably compounded, will also surpass natural rubber sheets, according to accelerated aging tests; 7) flexibility of the saturated papers at low temperatures is superior to that of the resin-treated papers; 8) tear strengths of natural latex standards have been approached more nearly with synthetic rubber than with resin; 9) it is compatible with reclaimed rubber and natural Hevea latex. Some of the poorer properties of GR-S are as follows: 1) it has poor tensile strength for its high elongation, imparting a relatively "dead feel" to the saturated paper; the synthetic is nevertheless superior to the resin in this respect; 2) it vulcanizes at a slower rate than natural rubber; 3) the GR-S pure latex rubber has poor film tear under stress; 4) the colloid is generally less stable in production than either natural latex or resin emulsion; 5) the film has limited compatibilities which inhibit reinforcement by other known plastics.

SOME LOW-TEMPERATURE PROPERTIES OF ELASTOMERS. F. S. Conant and J. W. Liska. J. Applied Phys. *15,* 767–78 (Nov. 1944). A modification of the apparatus employed in measuring the Young's modulus of elastomers at low temperatures is described. The changes made in the apparatus permit the use of a simplified technique which can be adapted to routine testing procedure. The effects of various plasticizers on the low temperature bending moduli and the brittle point temperatures of stocks based on 4 butadiene-acrylonitrile type copolymers are given. It is shown that the plasticizers tested have the same relative effects in all four types and that a wide variation in low temperature properties is imparted to the stocks by the different plasticizers. The low-temperature Young's modulus of the butadiene-acrylonitrile type is lowered by decreasing the acrylonitrile content. Bending modulus curves and brittle point temperatures are given for typical test stocks based on Thiokol FA, and "mass" and "emulsion" polymerized polybutadiene. It is shown that continued exposure to low temperature affects the Young's modulus of some but not all typical vulcanizates. Data are presented showing this effect on an uncured Hevea gum stock held at 0° C. Certain plasticizers were found to induce time effects in one of the butadiene-acrylonitrile stocks, which exhibits no crystallization, and hence no progressive stiffening in the absence of the given plasticizers. A method for measuring and evaluating creep under dead load at low temperatures is presented. Accompanying data indicate that in the case of those stocks tested, the creep constant defined reaches a maximum at a definite temperature which is found to be a characteristic of the given stock.

EFFECT OF DEFORMATION ON THE SWELLING CAPACITY OF RUBBER. P. J. Flory and J. Rehner, Jr. J. Chem. Phys. *12,* 412–14 (Oct. 1944). Elongation of swollen vulcanized rubber, or other polymeric materials possessing random network structures, should increase the amount of liquid absorbed at equilibrium with an excess of the swelling agent. According to a previously published equation relating to the thermodynamics of stretching and swelling of rubber, the relative volume of the swollen rubber at equilibrium should equal the square root of the relative stretched length. Experiments with butyl rubber vulcanizates in xylene are reported which support these predictions of theory.

PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

ORGANO-SILICON FILMS. F. J. Norton. General Electric Rev. *47*, 6–16 (Aug. 1944). The exposure of various materials to the vapors of organo-halogeno-silanes such as methyl-chlorosilanes results in the deposition of a very thin, stable, non-volatile, water-repellent layer on the surface. This layer is probably a high molecular weight material consisting of a chain of alternate oxygen and silicon atoms with two methyl groups on each silicon atom. Films of this type greatly increase the electrical surface-leakage resistance of steatite and other ceramic insulators under humid conditions and particularly when moisture is condensed on the surface. The method of application of such films and the results of tests made at various humidities and over extended periods of time are described. Relatively small changes occur during normal indoor storage. The treatment is not recommended for out-of-door use.

POTENTIALITIES OF PAPER-BASE LAMINATES AS COMPARED WITH OTHER LAMINATES. A. J. Stamm. Paper Trade J. *118*, 39–41 (May 25, 1944). Plastics should continue to increase in importance in the coming postwar era as they have during the war period. Of the different types of plastics, the laminates might be predicted to have the greatest future possibilities. A brief comparison between the cost properties and advantages and disadvantages of laminates made from glass fabric, cotton fabric, asbestos paper and fabric, paper and wood veneer is given. Paper seems to show the broadest scope of possibilities. Cross-banded laminated paper plastics are now being made that equal the best of the other cross-banded laminates per unit weight, with the possible exception of the newer glass fabric laminates, in all important strength properties except impact strength and yield strength in compression. The latter can be increased at the expense of a further loss in toughness.

SILICONE RUBBER. Rubber Age *56*, 173–5 (Nov. 1944). Silicone rubber, a new rubber-like material, is described. The silicone rubber molecule consists of a chain of alternate silicon and oxygen atoms with two methyl groups attached to each of the silicon atoms. This product retains its elastic properties at –60° F. and at 575° F., has a low compression set, and is unaffected by ozone, corona and ultraviolet light. The tensile strength and tear resistance are extremely low. It is not compatible with natural or other synthetic rubbers. Silicone rubber may be handled with standard processing equipment, compounded with standard fillers, extruded and molded. The material is being used for gaskets for B-29 turbosuperchargers and also for searchlights.

Materials

CONDENSATION OF FORMALDEHYDE WITH UREA IN THE PRESENCE OF ORGANIC ACIDS AND HEXAMETHYLENETETRAMINE. A. A. Vansheĭdt and Z. K. Naumova. J. Chem. Ind. (U. S. S. R.) *18*, No. 7, 11–17 (1941); Chem. Abstracts *38*, 3747 (July 20, 1944). A satisfactory molding powder is made by heating 1.5 parts formaldehyde and 1 part urea with 5 percent hexamethylenetetramine and 0.5 percent oxalic acid at 50° C. for 1 to 2 hours. The pH rises and then falls to 5.1 to 5.5 when the resin precipitates. The product is dried at 70 to 80° C. Increasing the amount of formaldehyde decreases the rate of the reaction. Increasing the amount of hexamethylenetetramine decreases the rate of fall of pH and therefore retards the precipitation of the resin. The oxalic acid lowers the pH and hastens precipitation of the resin. The initial rise in pH is eliminated when equivalent amounts of formaldehyde and ammonia are substituted for the hexamethylenetetramine. Increasing temperature increases rate of reaction. Methylolureas are formed at room temperature.

VULCANIZED ACRYLIC RESINS. W. C. Mast, L. T. Smith and C. H. Fisher. Ind. Eng. Chem. *36*, 1027–31 (Nov. 1944). Rubberlike materials were made by copolymerizing emulsified ethyl acrylate with small proportions of allyl maleate and vulcanizing the resulting unsaturated acrylic resins with sulfur and accelerators and with other agents in the absence of sulfur. Acrylonitrile (preferably about 6 percent) and the dodecyl mercaptan had a beneficial effect, possibly because of their tendency to decrease cross linkage. Ammonium persulfate was preferable as a polymerization catalyst; a small amount caused polymerization to proceed smoothly. Benzoyl peroxide was also effective but produced properties, such as insolubility and toughness, that are sometimes attributed to cross linkage. Although not so active as benzoyl peroxide, hydrogen peroxide was moderately satisfactory. Sodium perborate had no advantage. Nonsulfur vulcanization gave promising results. Combinations of quinone dioxime, quinone dioxime dibenzoate, red lead and lead peroxide produced vulcanizates with considerably higher tensile strength and somewhat greater hardness than did sulfur.

VULCANIZATION OF SATURATED ACRYLIC RESINS. W. C. Mast, C. E. Rehberg, T. J. Dietz and C. H. Fisher. Ind. Eng. Chem. *36*, 1022–7 (Nov 1944). Rubberlike materials, designated as Lactoprene, were prepared in earlier investigations by copolymerizing ethyl acrylate with small proportions of butadiene, isoprene or allyl maleate, compounding the resulting copolymers (assumed to have olefinic unsaturation) with sulfur and accelerators, and then curing the compounded products. Since it was difficult to prevent cross linkage during polymerization of mixtures containing butadiene and other polyfunctional monomers, vulcanization of acrylic resins not having olefinic linkage was attempted. Polyethyl acrylate and various saturated copolymers of ethyl acrylate were vulcanized satisfactorily with red lead and quinone dioxime and also with benzoyl peroxide. The copolymers made from acrylonitrile, cyanoethyl acrylate, chloroethyl acrylate, chloropropyl acrylate and phenyl acrylate were vulcanizable with certain sulfur-accelerator mixtures. The preparation of rubberlike materials by vulcanizing saturated acrylic resins instead of copolymers of the ethyl acrylate-butadiene type has the following advantages: 1) Agents and techniques to prevent cross linkage are not required; 2) the polymers and copolymers are soluble, and hence the viscosity of the solutions can be used as an index of the molecular weight; 3) synthetic rubber cements can be made. Physical properties of the copolymers are reported.

Molding and fabricating

A NEW METHOD OF MOLDING THERMOPLASTICS. A. D. Ferguson. British Plastics *16*, 430–2 (Oct. 1944). A new method of molding thermoplastics by extrusion is described. The plastic is forced by means of a screw extruder into a closed mold. The molding is done at 200 to 400 p. s. i. The machine is being used to mold polythene. Because of the relatively low molding pressure it is possible to obtain accurate positioning of flimsy inserts and insu-

lated wires in the molding. When molding polythene the screw gets rid of any bubbles that happen to be in the material, and these are ejected at the hopper. This is a valuable asset in the case of moldings used for electrical purposes and it is probably due to the gradually increasing pressure imposed on the material during its passage along the screw. As the machine is of the continuous feed type, very large moldings can be made by a small machine of relatively low initial cost, of correspondingly low running cost and occupying small floor area. Because of the low pressure employed, the molds may be of very light construction of brass or low grade steel, and are, therefore, correspondingly low in cost. This has the important advantage of enabling small quantity production to be carried out economically.

INJECTION MOLDING OF SUPERPOLYAMIDES. H. Gastrow Kunststoff-Tech. u. Kunststoff-Anwend. *33,* 159–60 (1943); Chem. Abstracts *38,* 5324 (Oct. 10, 1944). The injection molding of the heat-resistant superpolyamides is described. Special modifications of the equipment and technique are necessary because of the very narrow temperature liquefaction range of the common types of superpolyamides.

INFRARED GAS HEATING. British Plastics *16,* 497–8 (Nov. 1944). Infrared gas heating equipment for heating thermoplastic sheet materials for forming operations is described. The black steel emitter panel is heated to 600–650° F. by the gas flames. The apparatus is simple, cheap, economical to operate and efficient. The wave length of the infrared rays which are the most efficient for heating acrylic plastic sheet is between 30,000 and 40,000 A. U.

Applications

"VINYON" AS A PLASTIC FIBER. H. E. Shearer. Rayon Textile Monthly *25,* 431–3 (Sept. 1944). The properties of two commercial vinyl chloride acetate fibers are reported.

THEY SHALL WALK AGAIN. E. F. Lougee. Pacific Plastics *2,* 26–28 (Oct. 1944). The use of a fabric-laminated thermoplastic in the manufacture of artificial limbs is reported and described. The plastic limbs are tailored to the customer, light in weight, strong and economical to produce.

SYNTHETIC BONDED MICA. L. E. Barringer and K. N. Mathes. General Electric Rev. *47,* 15–19 (Oct. 1944). The use of shellac, alkyd resin and a new synthetic resin in building up mica plate by cementing together the thin layers of mica is described. Methods of test and the properties of the products are discussed. The alkyd resin bond has produced built-up mica insulation with the following advantages over the shellac-bonded mica: 1) it withstands higher temperatures without physical or chemical change; 2) the bond is less readily carbonized; 3) the decomposition products of the bond are nonconducting; 4) it is physically denser and stronger; 5) it has lower power factor, higher resistivity (both volume and surface), and higher dielectric strength. The new synthetic resin bond produces built-up mica which retains all of the advantages of the alkyd bond and, in addition, possesses the added advantage of greater stability under combined heat and pressure.

METLBOND—A METAL ADHESIVE FOR AIRCRAFT. G. G. Havens. Mechanical Eng. *66,* 713–14, 736 (Nov. 1944). Various types of organic adhesives for various purposes are described. The adhesives are based on synthetic rubbers and plastics. Adhesives for bonding aluminum alloys, magnesium, steel, zinc, cadmium, brass, glass fibers, cotton, rayon, plastics, wood and rubbers have been developed. The best bonds are obtained with smooth surfaces. They are resistant to high temperatures.

PLANES IN ENVELOPES. Modern Packaging *18,* 108–9, 162 (Nov. 1944). Airplanes are protected in transit by spraying them with a vinyl resin lacquer which encloses them completely in an envelope of plastic film. The plastic composition consists of a vinyl chloride acetate resin, a stabilizer and a plasticizer. Adequate protection in a temperature range of -40 to 180°F. is obtained. The minimum thickness required is 0.015 inch. The coating is elastic and flexible. An airplane can be completely covered by two men in less than an hour. On arrival at its destination, the coating can be slit and peeled off by three or four men in about an hour. The coating will not pull or lift the paint when it is stripped. Both cold and hot spray coatings are available.

A LIGHTWEIGHT FLOOR FOR AIRPLANES. J. R. Fitzpatrick. Mechanical Eng. *66,* 705–9 (Nov. 1944). Hollow-core plywood panels designed for aircraft flooring are described. The panels are made with the use of a hot-press phenolic resin adhesive.

RESINOUS MATERIALS IN THE PROCESSING OF PAPER. J. Y. Kao, L. Gold, A. Stull, R. Worden and W. Abramowitz. Paper Trade J. *119,* 42–7 (July 20, 1944). With paper as a base or matrix, synthetic resins and allied substances are applied to yield combinations of protective, decorative, and dielectric properties which can be varied at will. This comprehensive report outlines the tremendous activity in the field of processed papers in the following order: 1) the military and important civilian uses, 2) properties to be imparted, 3) adhesives for paper, and 4) principal methods of treating, coating, lamination and impregnation. A long detailed list of the uses of papers which are modified by synthetic resins and allied substances is given. The resinous materials used are listed, the properties of the films are reported and the applications of each type are outlined.

Coatings

THIS FABRIC TESTER TAKES OUT THE GUESSWORK. Aviation *43,* 181 (Oct. 1944). An instrument for testing doped fabric to determine if the fabric is rotten or the dope is brittle is described in this article.

THE RELATION OF THE PLASTICIZER TO THE ADHERENCE OF A SURFACE LACQUER. G. F. Rossi. Vernici *17,* 475–80 (1941); Chem. Abstracts *38,* 3858–9 (July 20, 1944). The adhesion of a lacquer is not affected by large changes in plasticizer content. Spreading power and crystallization of the lacquer do affect the adhesion. The addition of 40 percent triphenyl phosphate improves the adhesion of cellulose acetate lacquers.

A NEEDED IMPROVEMENT IN BAKING CONTROL METHODS FOR ORGANIC FINISHES. S. Graves. Ind. Eng. Chem. Anal. Ed. *16,* 599–602 (Oct. 1944). Numerous variables introduce large errors in the control of short-time organic enamel baking operations. A relatively simple baking control method is described which compensates for these variables and gives comparable enamel film properties under widely varying baking conditions. It is based on enamel film or metal temperature determinations and the calculation of consequent reaction velocity. An instrument is also described which automatically makes the necessary temperature measurements and calculations, and continuously indicates the percentage completion of the baking operation, according to predetermined standards.

NORELAC. A PROPOSED NEW SYNTHETIC COATING MATERIAL. J. C. Cowan, A. J. Lewis and L. B. Falkenburg. Oil and Soap *21,* 101–7 (April, 1944). Norelac is prepared by heating a mixture of equivalent amounts of ethylenediamine and polymerized fatty acids or esters. Norelac is soluble in alcohols, amines, fatty acids, some aldehydes, some ketones, and a few halogenated hydrocarbons. It is insoluble in hydrocarbons, esters, glycols, nitroparaffins and most halogenated hydrocarbons. Norelac is superior to ethylcellulose, cellulose nitrate, orange shellac and dammar varnish in resistance to water, acids and alkalis; it is inferior in resistance to hot water.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

MOLDING. R. D. Lowry and R. C. Reinhardt (to Dow Chemical Co.). U.S. 2,361,900, Oct. 31. Polymeric vinylidene chloride or its copolymers are fused and injected into a mold heated at such a temperature as to allow the recrystallization of the polymer.

INSOLE. R. B. Harrison (to Beckwith Mfg. Co.). U.S. 2,361,941, Nov. 7. Ribbed insoles are prepared by channeling a leather blank, turning up and cementing the channel lips, applying the liquid resinous monomer and then polymerizing it in situ.

PHENOLIC RESINS. A. P. Mazzucchelli (to Bakelite Corp.). U.S. 2,362,018, Nov. 7. A phenolic resin prepared by reacting phenol, formaldehyde and a cresol with an acid and a drying oil.

POLYVINYL ALCOHOL. J. D. Quist (to U. S. Rubber Co.). U.S. 2,362,026, Nov. 7. Polyvinyl alcohol is made water resistant by the presence of a water-insoluble secondary aromatic amine and a chloride of an amphoteric metal.

ANION EXCHANGE RESIN. R. J. Myers and J. W. Eastes (to Resinous Products and Chemical Co.). U.S. 2,362,086, Nov. 7. An anion exchange resin prepared from a methylol-forming phenol, formaldehyde and a non-aromatic amine which has hydrogen available for substitution.

POLYMER. M. W. Renoll (to Monsanto Chemical Co.). U.S. 2,362,094, Nov. 7. Polymeric 1-chloro-1-fluoroethylene.

COATING. J. K. Speicher (to Hercules Powder Co.). U.S. 2,362,166, Nov. 7. Plasticized ethyl cellulose is powdered, passed through a flame until melted and then impinged on a surface to form an adherent protective coating.

CELLULOSE ACETATE. W. O. Baker (to Bell Telephone Laboratories, Inc.). U.S. 2,362,182, Nov. 7. Cellulose triacetate is swelled in a solvent at -75° C. and the temperature slowly raised until solution occurs.

PHENOLIC RESINS. D. A. Hurst (to Allied Chemical and Dye Corp). U.S. 2,362,274, Nov. 7. Aqueous phenolic resin solutions are prepared by reacting formaldehyde with a tar acid containing cresols and mixing the product with water and formaldehyde.

VINYL POLYMERS. K. Heymann (to American Viscose Corp.). U.S. 2,362,375-6-7, Nov. 7. Methods for dyeing yarns and other shapes of vinyl polymers.

COATINGS. W. T. Pearce (to Resinous Products and Chemical Co.). U.S. 2,362,397, Nov. 7. A coating for metal consisting of a polyvinyl halide, a polyvinyl ester or polyacrylic esters, is heated and applied to the metal at the same temperature.

MOLD. W. P. Cousino (to Chrysler Corp.). U.S. 2,362,469, Nov. 14. Apparatus for injection molding plastic material.

RESIN. W. O. Teeters (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,362,511, Nov. 14. Resins are prepared by reacting a mixture of glycolic acid, water and lactic acid at 200° C. for 2 hr. and continuing the heating for ½ hr. under vacuum.

CELLULOSE DERIVATIVES. C. J. Malm (to Eastman Kodak Co.). U.S. 2,362,575-6, Nov. 14. An esterification process for preparing mixed cellulose esters.

LAMINATE. G. F. Nadeau and C. B. Starck (to Eastman Kodak Co.). U.S. 2,362,580, Nov. 14. A laminate comprising a cellulose ester support, a cellulose nitrate subbing layer, and a layer of a polyvinyl alcohol.

CELLULOSE ETHER. R. C. Medl, Jr. (to Hercules Powder Co.). U.S. 2,362,761, Nov. 14. A coating comprising a water-soluble cellulose ether and a condensate of a polyhydric alcohol and an inorganic polybasic acid.

RESIN. W. Reppe, O. Hecht and F. Oschatz (to General Aniline and Film Corp.). U.S. 2,362,858, Nov. 14. A film-forming composition comprising the reaction product of a furane derivative and formaldehyde.

COATING. L. Balassa (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,362,876, Nov. 14. A coating comprising a solution of ethyl cellulose and an oleoresinous film-forming agent.

RESIN. R. F. B. Cox (to Hercules Powder Co.). U.S. 2,362,888, Nov. 14. A resin is prepared by heating a reaction mixture of a rosin ester, an alkaline earth metal and an inert solvent at a temperature of 80 to 200° C. for ½ to 8 hours.

CELLULOSE ETHERS. W. H. Groombridge and J. Downing. U.S. 2,362,900, Nov. 14. Cellulose ethers are produced by treating cellulose with an alkaline solution, adding an inert azeotropic liquid, distilling, removing water from the liquid and re-adding the anhydrous liquid, adding an etherifying agent, reacting with heat, adding additional alkali solution and then repeating the entire operation for three or perhaps more reaction stages.

VINYL COPOLYMER. C. A. Thomas (to Monsanto Chemical Co.). U.S. 2,362,960, Nov. 14. A resin is prepared by subjecting a mixture of vinyl fluoride and vinyl chloride to polymerization conditions.

COMPOSITION. W. E. Welch (to Monsanto Chemical Co.) U.S. 2,362,961, Nov. 14. A composition comprising a polyvinyl acetal resin and rubber in the proportions of 45 parts of resin to 50 parts of rubber.

FIBERS. M. O. Schürmann and J. D. Holtz (to Alien Property Custodian). U. S. 2,363,019, Nov. 21. A horsehair substitute is prepared by impregnating regenerated cellulose fibers with urea-formaldehyde resin and curing it.

POLYMER. G. Allen (to Petrolite Corp., Ltd.). U.S. 2,363,034, Nov. 21. A triethanolamine-reacted sub-rubbery polymeric sulfur-converted tri-ricinolein resin is prepared by reacting a high molal detergent-forming monocarboxy ester, sulfur and the alkanolamine at 150 to 190° C.

POLYMER. G. Allen (to Petrolite Corp., Ltd.). U.S. 2,363,035, Nov. 21. A triethanolamine-reacted phthalic-acid-reacted sub-rubbery polymeric sulfur-converted tri-ricinolein resin is prepared by reacting a high molal detergent-forming monocarboxy ester, sulfur, the alkanolamine and the polycarboxylic acid at 150 to 190° C.

ACRYLIC ACID ESTERS. A. M. Clifford (to Wingfoot Corp.). U.S. 2,363,044, Nov. 21. Polymerized terpinyl methacrylate.

CELLULOSE ESTERS. G. W. Seymour and B. B. White (to Celanese Corp. of America). U.S. 2,363,091, Nov. 21. Mixed esters are prepared by esterifying the cellulose with formic-acetic anhydride.

COATING. P. D. Watson (to United States of America). U.S. 2,363,103, Nov. 21. A coating prepared by heating a mixture of polylactylic acids and a drying oil is applied to metal and baked.

MOLD. S. H. A. Young. U.S. 2,363,107, Nov. 21. A mold for fibrous plastic substances.

RESINS. G. F. D'Alelio (General Electric Co.). U.S. 2,363,297, Nov. 21. The reaction product of the hydrolyzed, insoluble, infusible copolymer of a vinyl ester of an organic acid and a divinyl aryl compound with an aldehyde or a ketone.

WELT INSOLES. W. C. Wright (to Wright-Batchelder Corp.). U.S. 2,363,455-6, Nov. 21. A welt insole comprising an insole blank and a sewing rib of a vinyl material.

NACREOUS MATERIAL. A. F. Caprio (to Celanese Corp. of America). U.S. 2,363,570, Nov. 28. Artificial mother-of-pearl is prepared by suspending a magnesium, manganese, or zinc salt of ammonium phosphate in cellulose acetate, casein, phenol-formaldehyde or urea-formaldehyde.

POLYESTERS. C. J. Frosch (to Bell Telephone Laboratories, Inc.). U.S. 2,363,581, Nov. 28. A cold-drawing polyester produced by a dihydroxy glycol esterified with a dicarboxylic acid in the presence of glycerol.

POLYSULFIDE POLYMERS. J. C. Patrick (to Thiokol Corp.). U.S. 2,363,614, Nov. 28. Copolymers of alkyl polysulfides.

POLYSULFIDES. J. C. Patrick (to Thiokol Corp.). U.S. 2,363,615, Nov. 28. Copolymers of alkyl, aryl and aralkyl polysulfides.

COPOLYMERS. J. C. Patrick (to Thiokol Corp.). U.S. 2,363,616, Nov. 28. Polymers produced by the reacting of an alkaline metallic polysulfide with an aldehyde.

COPOLYMERS. J. C. Patrick (to Thiokol Corp.). U.S. 2,363,617, Nov. 28. Copolymers of butadiene and acrylonitrile or styrene plasticized with polyglycol halides or polyglycol esters of lower fatty acids.

COPOLYMERS. J. C. Patrick (to Thiokol Corp.). U.S. 2,363,618, Nov. 28. A copolymer of butadiene and acrylonitrile or styrene is plasticized with the lower fatty acid ester of a poly-thioglycol.

MOLDING COMPOSITION. L. E. Daly (to U. S. Rubber Co.). U.S. 2,363,654, Nov. 28. A hard thermoplastic which is the conversion product obtained by heating a vulcanizable rubber, a curing agent, and a hard resinous rubber obtained by heating rubber in an excess of phenol.

MOLDING. G. B. Sayre (to Boonton Molding Co.). U.S. 2,363,808, Nov. 28. A device for the molding of threaded objects.

MOLDING. M. Yellin. U.S. 2,363,826, Nov. 28. A device for molding spiral objects of plastic material.

RESIN. S. Caplan and M. T. Harvey (to Harvel Research Corp.). U.S. 2,363,829, Nov. 28. An infusible material obtained by curing with heat under alkaline conditions, the product of the successive reactions comprising reacting furfuraldehyde with a ketone in the presence of alkali, and then reacting with formaldehyde in the presence of acid.

RESINS. G. F. D'Alelio (to General Electric Co.). U.S. 2,363,836, Nov. 28. A polymer resulting from the reaction of divinyl benzene with a dialkyl benzene in the presence of a cupric inhibitor and a polymerization catalyst.

LOOSELEAF BINDER. C. E. Emmer (to General Binding Corp.). U.S. 2,363,848, Nov. 28. A looseleaf binder composed of a thermoplastic resin.

RESINS. J. B. Monier. U.S. 2,363,893, Nov. 28. A resinous mass comprising the condensate of phenol and formaldehyde modified with a formaldehyde-soluble acetate of gelatin, an abieto acetate of gelatin, or a boro-abieto acetate of a gelatin.

POLYMERS. H. Fikentscher (to General Aniline and Film Corp.). U.S. 2,363,951, Nov. 28. A polymerization process comprising reacting water-soluble organic monomers which give water-insoluble polymers in a high column of water, removing the separated polymers from the bottom of the column and adding fresh monomer at the top.

VINYL RESINS. A. L. Marshall (to Monsanto Chemical Co.). U.S. 2,364,027, Nov. 28. Polyvinyl compounds are color stabilized with aromatic hydrocarbons having less than three fused benzene nuclei and having adjacent hydroxyl and carbonyl groups on the aromatic nucleus.

CELLULOSE ETHERS. F. C. Peterson (to Dow Chemical Co.). U.S. 2,364,028, Nov. 28. A process for preparing methyl cellulose in compact form, readily soluble in water.

RUBBERLIKE POLYMER. O. Huppert. U.S. 2,364,034, Nov. 28. Rubberlike thermoplastic products of high molecular weight are prepared by reacting a protein, monochloracetic acid, ammonium-sulfocyanide and a phenol at 100° C., adding an aldehyde and heating further at 100° C.

PLASTIC. O. Huppert. U.S. 2,364,035, Nov. 28. Soybean fiber is strengthened and rendered more flexible and water resistant by treating with a copolymer of pseudothiohydantoin-zein, cresylic acid and formaldehyde.

SHOE SOLE. J. N. Dow and A. T. Dildilian (to Bigelow-Sanford Carpet Co., Inc.). U.S. 2,364,134, Dec. 5. A shoe sole having an attached plastic welt.

RESIN. J. A. Mitchell (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,364,158, Dec. 5. A resin comprising a phenol-rubber product reacted with maleic anhydride.

COATING. H. G. Stauffer (to E. I. du Pont de Nemours and Co., Inc.) U.S. 2,364,172, Dec 5. A coating comprising a vinyl resin, a reaction product of urea and amino triazines with formaldehyde, and a monohydric alcohol.

RESIN. F. C. Bersworth (to Martin Dennis Co.). U.S. 2,364,186, Dec. 5. A resin produced by heating to boiling a mixture of natural rubber and an organic amine.

PHENOLIC RESINS. W. Charlton, J. B. Harrison and R. B. Waters (to Imperial Chemical Industries, Ltd.). U.S. 2,364,192, Dec. 5. Phenolic resin varnishes are prepared by heating a di-o-methylol derivative of a *p*-alkyl-substituted monohydric phenol with an aliphatic aldehyde of 3 to 8 carbon atoms at a temperature of 70 to 160° C. in the presence of an acidic catalyst.

POLYAMIDES. C. S. Fuller (to Bell Telephone Laboratories, Inc.). U.S. 2,364,204, Dec. 5. A coating, comprising a synthetic polyamide resulting from the reaction of a saturated monoamino-monocarboxylic acid, and a mixture of a saturated diamine and a saturated dibasic carboxylic acid, is heated in the presence of oxygen for a short time above the melting point of the polyamide.

INLAID ARTICLE. J. J. Larmour (to Plastic Inlays, Inc.). U.S. 2,364,226, Dec. 5. A plastic molding material having a preformed channel adapted to receive portions of decorative thin-walled metallic members.

VINYL COMPOUNDS. J. R. Lewis, L. B. Morgan and J. T. Watts (to Imperial Chemical Industries, Ltd.). U.S. 2,364,227, Dec. 5. Vinyl chloride is polymerized in the form of an aqueous emulsion in the presence of a dispersing agent and isolated by precipitating with a water-soluble lead salt.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Plastic Molding and Plant Management

by D. A. Dearle

Chemical Publishing Co., Inc., Brooklyn, New York, 1944

Price $3.50 **196 pages**

In this book, the author has given a fairly simplified yet comprehensive discussion of plastic materials and problems relating to their manufacture and molding. We do not agree with the author when he states that "it is difficult to find much material pertaining to the actual problems which arise from day to day in the average compression or injection molding plant." It would appear from this statement that he has written his book for the benefit of those already engaged in working with and supervising workers on plastic materials, whereas we feel that this book is excellent reading matter, not for those working directly in plastics, but rather for people who must purchase plastics and executives of companies which make use of purchased plastic parts.

The twelve sections include two describing thermosetting and thermoplastic materials; one outlining molds and their construction; two detailing two types of molding with which the author is familiar — compression and injection; four discussing management problems, including problems of production and cost and defining and describing custom and proprietary molds. Another chapter is devoted to many pertinent questions which are bound to come up in the minds of people on first acquaintance with this new industry. The answers appear to be well thought out and clearly presented. F.B.S.

Rubber Red Book

Published by The Rubber Age, New York, N. Y., 1943

Price $5.00 **580 pages**

Published biennially, this Directory of the Rubber Industry is a comprehensive listing of complete data on all branches of the rubber industry. Sections are devoted to a listing of rubber manufacturers in the United States and Canada, machinery and equipment, rubber chemicals and compounding materials, fabrics and textiles, crude rubber and related materials, synthetic rubbers and other rubber-like materials, as well as information on technical journals, consulting technologists and other branches of the industry. A classified list of suppliers and addresses appear in each section.

Chemical Engineering Catalog 1944-45

Reinhold Publishing Corp., New York, N. Y.

Price $10.00 **1500 pages**

The 29th annual edition of this catalog for the process industries, contains condensed and standardized data on equipment, machinery, laboratory supplies, chemicals and raw materials used in industries employing chemical processes of manufacture, as well as classified indices of such equipment and materials. An index of trade names and a section on technical and scientific books are also included.

★ IN ANSWER TO NUMEROUS non-technical questions received by Hercules Powder Co., Inc., Wilmington, Del., a folder, "Why Cellulose Plastics?", has been prepared, containing a photographic resume in color of cellulose applications.

★ FAR-REACHING POSSIBILITIES of plastics in coatings is the subject of "20 Years of Plastic Surfacing," an attractively illustrated book received from Roxalin Flexible Finishes, Inc., Elizabeth, N. J. Nitrocellulose, phenolics, ethyl cellulose, vinyl chloride and acetate, cellulose acetate, urea and melamine, polyvinyl alcohol, acrylates, polyvinyl butyral and rubber-like elastomers, already known to us in solid form under various trade names, can claim such advantages as mar-, moisture-, acid- and mild alkali-resistance, strength, corrosion prevention, low flammability and color permanence when used for surfacing. They may be made into coatings for metal, fabric, wood, electrical cable and solid plastics. A brief history of Roxalin and important advantages of many of its finishes are included.

★ TWO RECENT PUBLICATIONS of the Plastics Dept., E. I. du Pont de Nemours & Co., Inc., Arlington, N. J., are devoted to a new improved heat-resistant Lucite molding powder (HM-122) and the fabrication of Plastacele (cellulose acetate plastic sheets). In the first, four added advantages are claimed for HM-122 Lucite: faster production, optical improvement, greater clarity and increased brilliance. These claims are substantiated with a properties chart and application photographs.

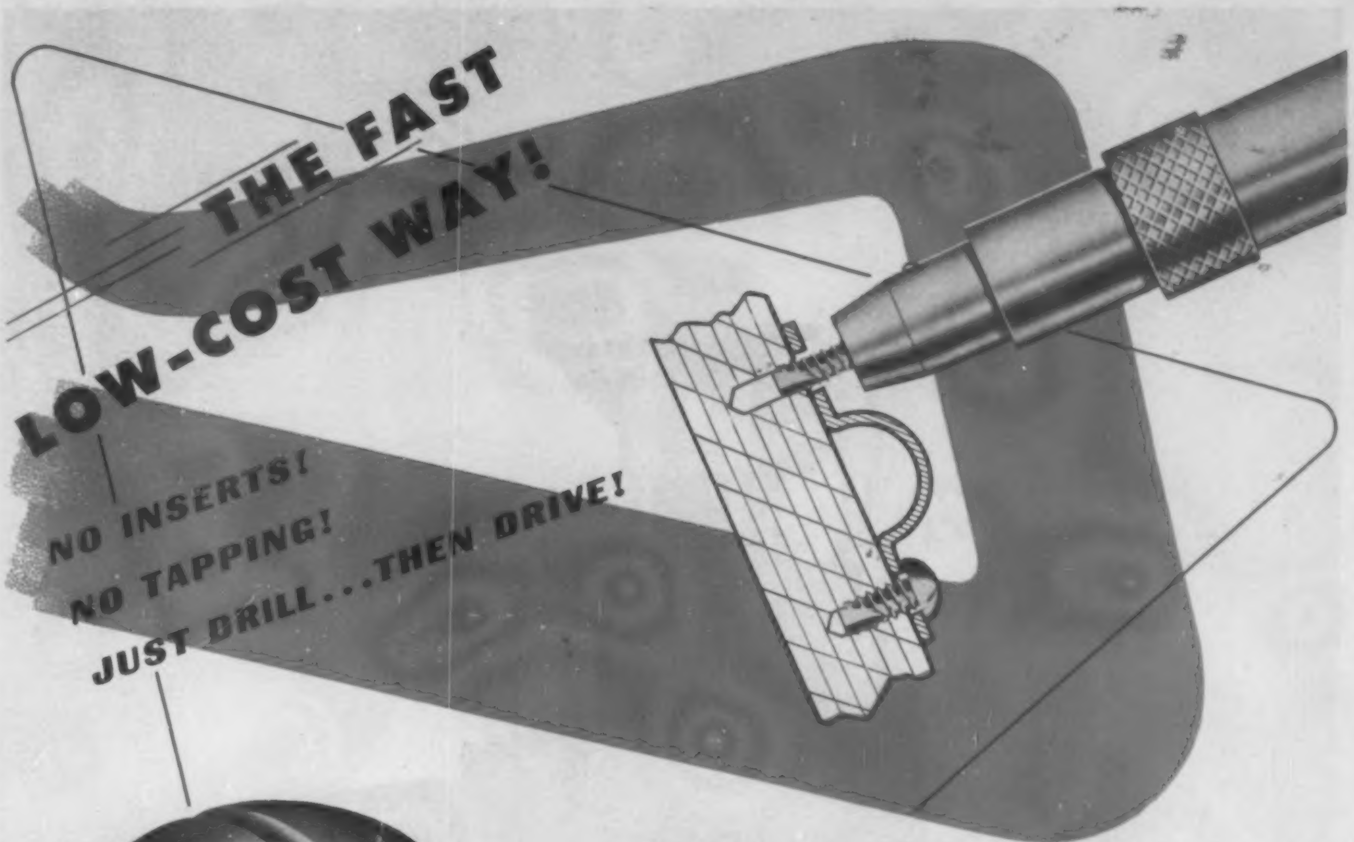
Plastacele — the subject of the second booklet — is available in sheets, varying from 0.020 to 0.250 in., in thickness and molding powders. Standard aircraft sheeting is colorless but the plastic can be made in transparent, translucent and opaque colors and in colored pearl and mottled effects. Typical applications include airport lighting unit shields, drafting instruments, goggle lenses and dial covers and faces. The major portion of the booklet is devoted to such information on fabricating as handling, types of machinery for best results and finishing operations. A table containing general physical properties of Plastacele completes the data.

★ GENERAL ELECTRIC CO., Schenectady, N. Y., has compiled a 96-page illustrated booklet summarizing practical applications of a modern scientific tool — industrial electronics. The brochure delineates such advantages as: power rectification and frequency conversion; adjustable-speed electronic drive — Thy-mo-trol; resistance welding control; electronic heating; temperature control; the electric eye; inspection, testing and counting; measurement; positioning control; speed matching and voltage control; electronic timing; lighting and lighting control; x-rays in industry; electrostatic precipitation; and carrier current.

★ A REVISED EDITION OF "Resins and the War" has been issued by U. S. Industrial Chemicals, Inc., New York, N. Y. Government agency specifications for various protective coatings are listed, together with the S&W resins suggested for use by the manufacturer.

★ FOUR PUBLICATIONS ILLUSTRATING and describing the 3-M method of grinding and finishing have been made available by Minnesota Mining and Manufacturing Co., St. Paul, Minn. "Step-up Production with the 3-M Method of Grinding and Finishing," the largest booklet, is designed to provide up-to-the-minute data on this method in a concise and usable form. The three small booklets deal with the 3-M method as applied to the grinding and finishing of small parts and tools, heavy duty grinding and finishing of flat or curved surfaces, and the method employing a semi-portable unit for grinding and conditioning raw metal stock.

(Please turn to page 202)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NO TAPPING!
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ANNOUNCING

THE JOHN WESLEY HYATT AWARD

FOR THE ADVANCEMENT OF PLASTICS

FOURTH ANNUAL AWARD, 1944

The John Wesley Hyatt Award, consisting of a gold medal and $1000, is made annually to the individual who has made, in the opinion of the judges, outstanding achievement of wide importance to the plastics industry.

ENTRIES

Any person, whether he be a molder, toolmaker, laboratory technician, executive, or engaged in any other capacity, is eligible to submit one or more entries. There is no fee of any kind. Anyone may enter or be entered. Statements of qualification (Entry Blanks) are being mailed to the Industry. Additional entry blanks may be obtained from the Committee Secretary, 295 Madison Avenue, New York.

PREVIOUS MEDALISTS

1941—Dr. Donald S. Frederick, Plastics Division, Rohm & Haas Company, Philadelphia, for adaptation of large transparent colorless sections of methyl-methacrylate to bombers and other military aircraft.

1942—Mr. Frank Shaw, President, Shaw Insulator Company, Irvington, N. J., for development of the process for transfer molding of thermosetting materials.

1943—Dr. Stuart D. Douglas, Head of Plastics Research, Carbide and Carbon Chemicals Corporation, South Charleston, W.Va., for his outstanding research work in the polymerization of vinyl compounds, the increased commercial production of which, in 1943, made possible the manufacture of war materials urgently needed by the nation for the prosecution of the war.

THE JOHN WESLEY HYATT AWARD

COMMITTEE FOR 1944:

RICHARD F. BACH
Dean of Education, The Metropolitan Museum of Art

DR. LYMAN J. BRIGGS
Director, National Bureau of Standards

DR. KARL T. COMPTON
President, Massachusetts Institute of Technology

WATSON DAVIS
Director, Science Service, Washington, D. C.

DR. CARL S. MARVEL
President, American Chemical Society

GEORGE K. SCRIBNER
President, Society of The Plastics Industry, Inc.

DR. STUART D. DOUGLAS
Carbide & Carbon Chemicals Corp., Hyatt Medalist, 1943

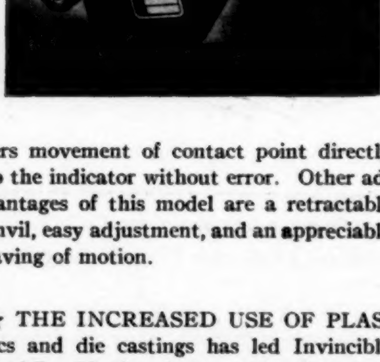
Committee Secretary:
WILLIAM T. CRUSE, 295 Madison Ave., New York

NEW MACHINERY AND EQUIPMENT

★ TWO NEW PRESSES HAVE BEEN added to the already extensive line produced by Watson-Stillman Co., Roselle, N. J.: a 200-ton molding press of the "moving-up" ram type with floating, center platen, and a 100-ton hydraulic molding press containing a top transfer cylinder and two rams. Among the interesting new features of the first-mentioned press are transfer molding attachments and an improved type of hydraulic, bottom strippers. It has an operating pressure of 2500 p.s.i. and the unit may be arranged for accumulator operation or can be furnished with self-contained power unit when desired.

The second and smaller press has an upward operating ram with a capacity of 100 tons for general molding and a downward operating 30-ton ram for transfer molding at pressures of 6 to 30 tons. The "stop, up and down" operations for both cylinders are controlled by conveniently located push-buttons. Pressure is supplied by two pumps. Separate pressure and inching handwheel controls for both cylinders are controlled by push-buttons through the medium of solenoid-controlled operating valves.

★ A VISUAL DIAL INDICATOR SNAP gage, Model 1330 P-100, manufactured by Federal Products Corp., Providence, R. I., can be adjusted easily to any dimension within one inch and locked in place. Light thumb pressure on the fixed contact, rather than on a sensitive contact, trans-



fers movement of contact point directly to the indicator without error. Other advantages of this model are a retractable anvil, easy adjustment, and an appreciable saving of motion.

★ THE INCREASED USE OF PLASTICS and die castings has led Invincible Tool Co., Pittsburgh, Pa., to develop a new line of 45 and 90° angle tool attachments to make easier the use of flexible shafts and rotary files in mold making. The tools are supplied with bronze or needle bearings. With the use of a specially developed grease, speeds up to 15,000 r.p.m. are possible with bronze bearings and 5000 r.p.m. with needle bearings. The company claims that breakage, distortion and defective parts can be avoided through the use of their attachments in conjunction with any low-speed portable drill or flexible shaft units.

★ PARAMOUNT BRAND FELT bobs are now available permanently mounted on $^1/_8$- or $^1/_4$-in. steel mandrels. Bacon Felt Co., Winchester, Mass., are manufacturing these mandrel-mounted bobs for use with portable air or electric tools, flexible shaft equipment, drill presses, lathes, etc. When the felt has worn out, a new mandrel-mounted bob can be slipped into place, thereby saving time which was originally used in fitting new felt on an old mandrel.

★ TO IMPROVE THE UTILITY OF surface grinders, Strong Manufacturing Co., Philadelphia, Pa., has developed a multi-purpose grinding attachment, which may be tilted forward or backward, giving any angle, thereby eliminating the necessity of removing a piece of work to obtain right- and left-hand pitches when cutting angles in two directions. The attachment is equipped with a precision indexing fixture for grinding flats, squares, hexagons and rectangles.

★ A "LIVE" LATHE CENTER FOR handling heavy loads up to almost six tons is produced by Ideal Commutator Dresser Co., Sycamore, Ill. The center, designated No. 6MH, has a guaranteed tolerance of 0.0000 to 0.0005. A special bearing arrangement is used to handle radial loads up to 5750 lb. and thrust loads up to 8500 pounds. Two precision ball bearings in tandem support the spindle at the front and two preloaded angular contact ball bearings support it at the rear of the housing. Two sealing rings are used for the positive protection of these bearings against chips, dust, coolant and other foreign matter.

★ RACINE TOOL AND MACHINE Co., Racine, Wis., is manufacturing hydraulic equipment, confined to systems using oil as the fluid medium and designed for a range of hydraulic pressures up to 1000 p.s.i.

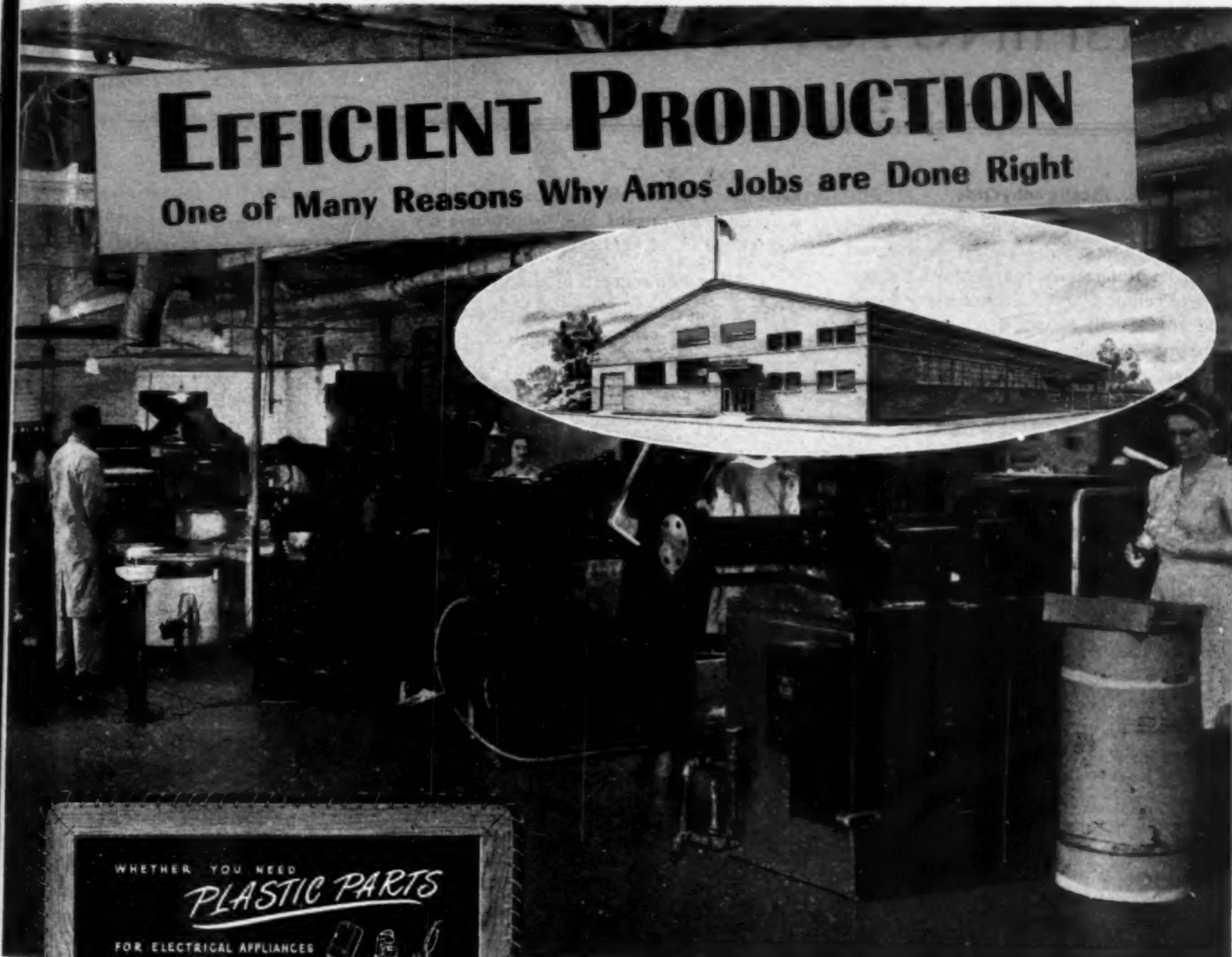
A variable volume pump, which is equipped with automatic volume control, permits greater flexibility because of the ability to vary the volume of oil pumped in accordance with requirements of operation. This principle is said to offer great economies in reducing horsepower consumption, eliminating bypass and relief valves and lessening oil heating.

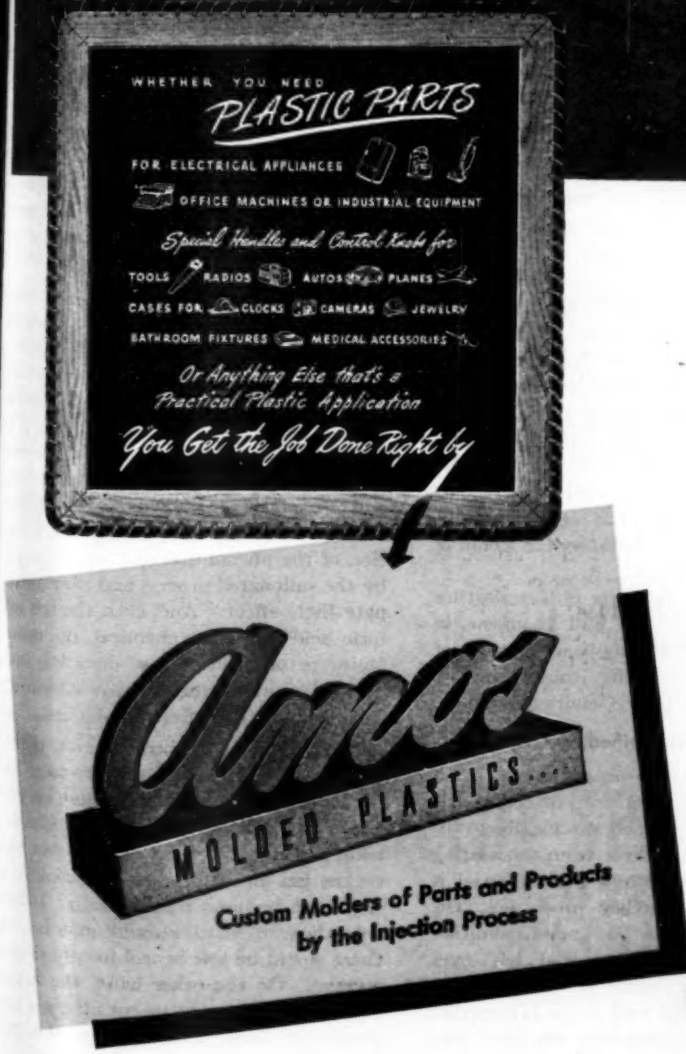
The hydraulic pressure booster, by the same company, is a simple, compact self-contained pumping unit which provides both high and low pressure. Among its many advantages are leak-proof construction, safety because of elimination of external working parts, low maintenance cost, high and low pressure from a single unit, standard low pressure valves and heating held to a minimum.

★ MODEL C MAGNI-RAY HAS been added to the line of Magni-Ray products manufacted by George Scherr Co., Inc., New York, N. Y. Designed to sim-

plify and speed up visual inspection operations, the unit has a high-grade optical glass lens, 5 in. in diameter. The magnifying device is supported by a triangular 12 by 12 by 12 in. cast-iron base for rigidity and stability. Two 4 in. long, 25-watt tubular bulbs reflect light directly upon the work. The model was planned for detection of cracks and imperfections in large castings but will be found of value in a variety of industries.

★ STANDARD MACHINERY CO., Providence, R. I., has made available a new form of tachometer, differing from others on the market in that its low weight—$5^1/_2$ oz., and small size—$2^1/_4$ in. in diameter, permit hand manipulation. Recordings in r.p.m. are read with ease; the readings are constant and record fluctuations. A pointed contact spindle is furnished for use with shafts that are centered; and an elastic tip slips over the pointed spindle for use with uncentered shafts. The range of the instrument extends from 500 to 3000 r.p.m.





To meet customer requirements exactly, you see here a battery of injection presses in the Amos plant—where any thermoplastic material is molded most efficiently. In the insert above, you see the new building—now under construction—to expand Amos facilities for molding plastic parts and products.

Efficient production is but one of many reasons why Amos jobs are done right. Other reasons include—experienced engineering—the right plastics in the right places—perfect die work—accurate finishing, with quality control of every operation.

From engineering to finishing, Amos does a complete job—and does it right. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS • EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

Acetic anhydride

Due to increased explosive requirements for acetic anhydride, it is believed that the amount needed in the manufacture of cellulose acetate for thermoplastics and rayon will be cut back at least 10 percent. No relief is expected until after the first quarter of 1945 when a new Texas plant should be in production.

Acetate order amended

Molders are no longer required to file customers' Form WPB-2945 to obtain cellulose acetate and cellulose acetate butyrate molding powder. They need merely file certified statements of proposed end use with their suppliers. Suppliers then file Form WPB-2947 on the basis of molders' certifications, instead of Form WPB-2946 as in the past. This action was taken by amending Schedule 52 to Chemicals Allocation Order M-300.

WPB now requires suppliers of these plastics materials to list only their customers with military orders, together with the end uses, and to ask for an aggregate quantity of materials for civilian distribution pursuant to Paragraph (f) of Order M-300 (special releases for civilian use). It has been suggested that contract numbers be made plainly visible on all direct war-use orders mailed to suppliers. Otherwise they may be treated as civilian requests by suppliers and WPB. Attention is again called to goods sold to Army PX or Navy Stores which are considered civilian goods by WPB and will *not* be given preferential treatment accorded military orders unless definitely proved to be for PX or Navy Stores in overseas stations.

Cellophane controls liberalized

The WPB has lifted quota restrictions on the use of cellophane for the packaging, wrapping or sealing of cigarettes, cigars, chewing or smoking tobacco, and bakery products. The annual consumption of cellophane for such purposes was formerly limited to 90 percent of the consumption in 1942. At the same time, cellulose caps and bands were removed from the controls of L-20. This action was taken, WPB said, because the entire output of caps is directed to the military and because there is an adequate quantity of bands available to meet all civilian needs.

Cigarettes may once more be packaged with a combination of aluminum foil and cellophane, formerly prohibited. This action, WPB said, will result in a substantial saving of paper. The new amendment also removed restrictions from use of cellophane in food packaging seals. It is estimated that 100,000 lb. of cellophane used in a year for this purpose will act as a preserving agent for approximately 10,000,000 lb. of food.

Allocation requests filed on time

WPB officials are calling attention to the plight of a molder whose allocation request came in 2 days late last month. The books had already been closed. Consequently, there is little chance that he will get his requested material for the current month. Officials point out that it is especially important at this time, while materials are extremely tight, to get orders into their hands either on or before the final filing date. It is impossible to process scattered orders after the entire amount of raw material has been allocated in accordance with the orders which were on file by the legal closing date. Officials also point out that interim orders for civilian items will not be processed; even on military items, interim orders will be processed only in cases of the most urgent necessity. Officials point out that WPB's manpower shortage plus increasing scarcities have added to the burdens of administrative officers and their staffs. They are hopeful that the industry will cooperate to the fullest extent in observing "the filing date."

Changes in WPB's plastics section

Nils Anderson, Jr., has been officially named as the new Chief of the Plastics Branch of the Chemicals Bureau, and George Sollenberger has been appointed Deputy Chief to succeed Mr. Anderson.

Mr. Anderson came to WPB three years ago after gaining his plastics experience with Bakelite Corp. in its adhesives branch. George Sollenberger joined the Plastics Section in Sept. 1942 as a commodities specialist for acrylics. He had formerly served as product design and technical sales representative for Rohm & Haas Co., in Chicago.

Harold Baker, formerly of Textileather Co., who succeeded Dr. Will Thompson in the Vinyls Unit last July is acting as chief of that unit, succeeding Robert Kenney who is now with B. F. Goodrich Co.

Scrap prices clarified by OPA

The definition of scrap in the regulation setting ceiling prices for thermoplastic scrap has been clarified specifically to include material left over from fabricating operations, even though that material is usable without further processing, the OPA announced. The new definition specifically excludes material left over from fabricating operations and recut to standard sizes for sale as new material. This action, effective Dec. 18, 1944, was taken, OPA said, because there has been a tendency on the part of some fabricators to collect a premium for scrap that could be used without further processing. There is no justification for the collection of this premium, the agency said.

Material left over from fabricating operations and recut to standard sizes for sale as new material is excluded from the definition of scrap because additional operations have been performed on it. These additional operations involve costs for which no allowance has been made by the ceiling price for scrap. Therefore, OPA said, this material will now be priced as material other than scrap under the applicable regulations. (Amendment No. 2 to Maximum Price Regulation No. 345—Thermoplastic Scrap—Effective Dec. 18, 1944.)

General chemical shortage

Many members of the industry are seriously concerned over reports of increasing chemical shortages as the war lengthens. But Chemicals Bureau officials point out that this is no time to get panicky. Materials are going to continue tight until Germany is whipped, and many of them will continue so until Japan, too, is subdued. Recent military developments in the Pacific and logistical problems involved indicate that original estimates on the amount of materials needed to fight Japan were probably too low.

It is true that chemical shortages must be taken seriously, but Chemicals Bureau officials feel that good headwork and teamwork on the part of their Bureau and the industry can prevent any serious breakdown. For example, there has been considerable talk about the sulfuric acid shortage (partially due to a lack of tank cars) and its effect on phenol. Responsible officials point out that a very small portion of the phenol manufactured today is by the sulfonated process and they anticipate little effect. And even though sulfuric acid is a basic chemical, the manufacturers of plastics raw materials contacted by this writer say that its scarcity should have little effect on plastics.

Benzol, too, may become even tighter because so many coal-tar products are needed for the increased ammunition program, and it is possible that the Government might even divert benzol from high octane gas and rubber for ammunition if the pinch becomes tight enough. If such were the case, plastics would suffer because there would be less benzol for phenol and styrene. On the other hand, the Armed Forces are not going to cut off their own noses and, since (*Please turn to page 200*)

NEWS OF THE INDUSTRY

★ ROBERT P. KENNEY, FORMER chief of vinyl resins unit, Chemicals Bureau, WPB, has been appointed Manager of International Service, Chemical Div., B. F. Goodrich Co., Akron, Ohio. Mr. Kenney will give technical assistance to foreign users of war purpose materials produced by the Chemical Division of B. F. Goodrich Co., bringing to bear his broad technical and administrative experiences gained in his former work with the Chemicals Bureau.

★ CELANESE PLASTICS CORP., New York, N. Y., announces the appointment of S. W. Jones, Jr., as assistant district manager of the New England district in Leominster, Mass. Simultaneously, announcement was made that W. R. Poucher will succeed Mr. Jones as assistant to the director of the Films and Foils Div. of the New York office.

★ NEILL S. GRAHAM HAS BECOME associated with Grobet File Co., 100 S. Jefferson St., Chicago, Ill., as manager and sales manager.

★ A NEW ENGLAND OFFICE HAS been opened at 6 Jersey St., Boston, Mass., by Maas & Waldstein Co., Newark, N. J. George F. Melanson, sales enginer, will supervise the office. Robert K. Waterman, sales engineer, has joined the staff of Maas & Waldstein and will be located at the Newark office.

★ LUMITE DIV., CHICOPEE MFG. Corp., announces the addition to its staff of George H. Day, 2nd, formerly with Yale & Towne Mfg. Co. Mr. Day's duties will consist of the formation of sales policies, and dealer and consumer education on the new plastic screen cloth, Lumite, now in production.

★ GEORGE F. WAITE, FORMERLY of the Dayton, Ohio, office of Celanese Plastics Corp., has become associated with Standard Molding Corp., Dayton, Ohio.

★ THE PLASTIC MATERIALS MANufacturers' Association elected W. Stuart Landes as president and J. R. Hoover as vice-president in their annual meeting held recently in New York. Mr. Landes is vice-president of Celanese Corp. of America in charge of the Plastics Div., and has previously served as vice-president of the Association. Mr. Hoover is general sales manager, Plastics Materials, Chemical Div., B. F. Goodrich Co.

Mr. Landes succeeds James L. Rodgers, Jr., of the Plaskon Div., Libby Owens Ford Glass Co., who will continue as a director. Dr. D. S. Frederick of the Rohm and Haas Co. was named as a new director. Other directors remaining in office are A. E. Pitcher of E. I. du Pont de Nemours and Co., Inc., and C. J. Romieux of the American Cyanamid Co. The Resin Adhesives Division, in an afternoon meeting, elected R. E. Dodd of the Durez Plastics and Chemicals Co. as chairman for 1945.

★ NEW QUARTERS FOR THE CENtral division of Continental Can Co. will be located on the third floor of the Field Building, Chicago, Ill. All divisions will be served from this office.

★ AFTER A TWO-YEAR ABSENCE, Fred Pickhardt has returned to Cruver Manufacturing Co., Chicago, Ill., as product designer and advertising assistant to E. R. Haan, general manager.

★ INCREASING REPRESENTATION to meet the increased demand for resin molding and glue materials, Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio, has made the following appointments and advancements: W. N. Shepard, sales manager of Plaskon glues and industrial resins, and R. B. Harrison, sales manager of Plaskon molding compounds. Both men will be located in Toledo.

New territorial assignments for Plaskon molding compound sales in the United States include: H. W. DeVore, Central; D. Howland, H. S. Vandersal and Prescott Huidekoper, Middle West; R. F. Mackessy, Middle Atlantic; and W. M. Bunting, New England. For Plaskon glue and laminating resin sales: C. L. Neely, Central; H. T. Yaryan, Middle West; W. C. Slicer, Middle Atlantic and New England; C. J. Fauth, Jr., South Central; and R. W. Burdeshaw, South Atlantic. Plaskon molding compounds and glues will be represented in Upper New York State by C. B. Wing. Plaskon interests in Washington will continue to be served by E. Bowman Stratton; and Plaskon industrial resins will be handled in the United States and Canada by H. E. Murray and R. M. McGee.

★ ZELLERBACH PAPER CO., LOS Angeles, Cal., will represent the Detroit Wax Paper Co. on the West Coast, with V. E. McIntyre as supervisor.

★ NATIONAL SCREW AND MFG. Co., Cleveland, Ohio, announces that Earl Benson will represent the company in Minnesota at 2645 University Ave., St. Paul. Electrical and Steel Sales Co., Inc., 241 E. Erie St., Milwaukee, will be the Wisconsin representatives.

★ DURAMOLD DIV., FAIRCHILD Engine and Airplane Corp., Hagerstown, Md., announces the appointment of T. Kelly Pierce to the post of general manager. Mr. Pierce will supervise production of new contracts for the United States Air Force.

★ DURA-BONDED—AN IMPROVEment in coated abrasives consisting of a treatment which hardens the adhesive and makes it more resistant to heat and less sensitive to humidity, has been developed by Behr-Manning, Troy, N. Y., division of Norton Co., Worcester, Mass. Reports from the metal working industry indicate an average of 20 percent longer life on fast-running belts, disks and other standard tools in this field.

★ E. V. CRANE, WIDELY KNOWN among the press-using industries, has resigned as Chief of Development Engineering, E. W. Bliss Co., Brooklyn, and is engaging upon confidential research investigations to be carried out in the field of press-worked materials

★ METALTEX INC., MANUFACturers of Lucite and Plexiglas articles, have opened a new plant at 98-100 Nassau St., Brooklyn, N. Y.

★ KURT W. JAPPE, MANAGER OF detonator operations, Hercules Powder Co., Wilmington, Del., has been appointed treasurer of the American Society of Mechanical Engineers, to succeed Dr. William D. Ennis who has retired after holding that office since 1935.

★ BARNES & REINECKE, INC., industrial engineers, have moved to 230 East Ohio St., Chicago, Ill.

★ ANNOUNCEMENT IS MADE that George B. Schwab has been elected treasurer and director of Heyden Chemical Corp., New York, N. Y.

★ DR. LEONARD BYMAN, CHEMIcal engineer, has become associated with the staff of Battelle Institute, Columbus, Ohio, where he will be engaged in chemical research.

★ RALPH T. URICH, CHIEF OF THE Synthetic Resins Section, Protective Coatings Branch, Chemicals Bureau, WPB, has rejoined Reichhold Chemicals, Inc., as sales manager of the Chemical Color Division. Mr. Urich will make his headquarters at the plant located at 105 Bedford Ave., Brooklyn, N. Y.

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Minute Ideas . . . Molded in PLASTICS

Whether your product is one requiring plastic parts of minute dimensions or one large enough to require giant molds and maximum molding pressures, Tech-Art will produce them for you economically and with those precision methods characteristic of Tech-Art's mechanical ingenuity and high engineering standards. For back of its every plastic achievement is the sound product engineering of Tech-Art's engineers . . . the practical knowledge of Tech-Art's skilled mold builders and craftsmen. This knowledge and skill plus Tech-Art's extensive production facilities has been responsible for its many plastic success stories.

A Series of Plastic Success Stories

4

In this illustration is shown a variety of miniature molded plastic parts which various industries brought to Tech-Art to mold. Each is a precision part, some of them containing inserts with threads as fine as 1-72. Each is a precision part of some manufacturer's complete products . . . each, in dimensions, material and workmanship, is exactly what each manufacturer specified. Each, in fact, is another in a whole series of Tech-Art Plastic Success Stories.

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BB

Synthetic textiles

(*Continued from page 102*) resins, nevertheless they welcomed the appearance of the synthetic rubbers when they became available for coatings. Neoprene, the earliest of the synthetics, had been in production for 10 years prior to the war, and it was at first used for all types of coatings, but its entire production was soon allocated for essential war uses, most of the coating supply going to the Corps of Engineers for pontoon boats or for barrage balloons. Buna N next appeared, but its production was limited and it was restricted to those purposes and coatings for which it is especially suited.

About 18 months ago, when butyl first became available in small quantities, the Navy began using it extensively in double-texture fabrics. (Butyl and polyvinyl butyral are still the most common Navy specifications for double texture laminates.) Butyl was also found to be superior to previous coatings for gas protective equipment, and the rest of the butyl supply was allocated largely to C.W.S. and the makers of inner tubes. Only in the last few months has butyl become available for Army coatings, but because of production difficulties the supply is still very small. The government sponsored its largest synthetic rubber program in buna S type rubber, and it is now the most available of all the synthetics, present production running ahead of consumption. In the last few months buna S has been much used for coating military equipment; it was found satisfactory for many single-texture coatings, but butyl is preferred for the double-texture fabrics because of its better adhesion.

In distinguishing between the properties of the various rubbers, it is important to remember that they are still in an experimental stage despite their substantial war production, and that compounding of the rubbers varies their properties greatly. Tremendous strides have been made in improving all the rubbers in the last 2 years, especially buna S, and some progress has been made in combining them—with each other and with the resins. One cannot speak categorically of their properties therefore, but on the basis of our present limited knowledge buna S appears to be a good all-purpose substitute for natural rubber where low temperature, good flexibility and volume production are to be considered. When compounded with carbon black it has good abrasion resistance, and good tensile strength and elongation, and for these reasons it was chosen as the rubber substitute for tires. In the coating field it is less popular than butyl because of its inability to flow (also a difficulty in tire making), and its relatively poor adhesion and cementing qualities.

Buna N is similar in most of its properties to buna S, but it is distinguished by its excellent resistance to oils; some coaters prefer it to buna S, but because of its limited production its use in the coating industry was restricted chiefly to bullet-proof fuel tanks, though some buna N also coated Army and Navy clothing.

Thiokols are little used in coating because of their odor, their poor cementability, and the fact that most of the solvents used with them are toxic. Thiokol coatings, however, have excellent resistance to gas and oil, and they have been used in self-sealing gas tanks for the Army, and in offset blankets for newspaper printing, and for paulins and tents on oil fields.

Neoprene has special adaptabilities in the coating of textiles because of its easy cementability and good adhesion. For outdoor exposure and weathering it is probably the best of the synthetic rubbers, and it has good oil resistance. In cold flexibility it is inferior to most of the other rubbers, but it has given excellent service during the war in coated fabrics for Army, Navy and Corps of Engineers' equipment.

Of all the synthetic rubbers, butyl is the favorite among proofers. This is not to say that butyl is "better" than the other rubbers, or even that it will remain the preferred rubber for textile coating, but its special adaptabilities in that field have placed it in great demand. Unfortunately the butyl supply is very limited because of production difficulties, and a large part of the present supply goes to making inner tubes. Butyl is superior in aging characteristics to the bunas, which rot and lose strength in outdoor aging; and its comparatively good weathering properties and low temperature flexibility make it a promising coating for the Army where durability is a first requisite. But the reason for its popularity among proofers is its ease in fabricating; only butyl is able to flow and knit like natural rubber without cementing. This flow characteristic gives it better building tack and adhesion.

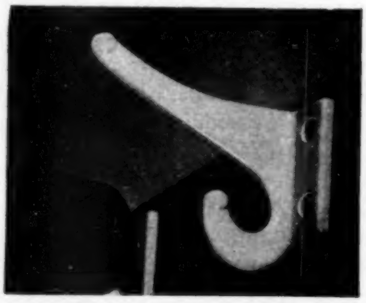
Synthetic rubbers, with the exception of butyl, must be cemented at the seams; butyl, however, like crude rubber, melts and flows in the curing ovens and knits together in one piece so that many seams are eliminated. Tires, for instance, are made of layers of tire cord plied together with layers of rubber compound which knit together into a solid mass during the cure (when the rubber used is crude or butyl). Plied, or laminated, fabrics are made in the same way with butyl, the plied fabric having greater strength than single cloth of the same thickness. The adhesion properties of butyl are even better than those of crude rubber, pointing the way to an increasing use of laminated fabrics. How important this quality may be is best seen in the field of footwear, where the synthetics now used (usually buna S) have to be cemented piece by piece. In the making of one single shoe or galosh, trim, lining, foxing and sole all have to be cemented by hand with a crude rubber cement. Thus the element of hand labor is very large, and there are many seconds.

Like the resins, then, each of the rubbers has its special aptitudes, butyl being perhaps the most adaptable for textile coating. One curious weakness which all the synthetic rubbers have in common with crude is their susceptibility to outdoor aging. Butyl and neoprene are superior to natural rubber in this respect, but none of the rubbers resists outdoor weathering in light colors—that is to say, none has weather resistance without the addition of carbon black. Carbon black reinforces both natural and synthetic rubber, giving to all of them increased sunlight resistance, and to some, like buna S, improved abrasion tensile strength and elongation. In this property of outdoor aging, the vinyl resins are superior to the rubbers, but they have the offsetting disadvantage of stiffening in low temperatures. One must remember, too, that for many consumer uses, such as sheeting and rainwear, outdoor aging is not a consideration; some buna S is now available for civilian uses, and it is being fabricated into crib sheets and infants' goods in pastel colors—delicate pinks and blues that are a far cry from the Army grays. Buna S coatings have an especially soft hand, very suitable for sheeting.

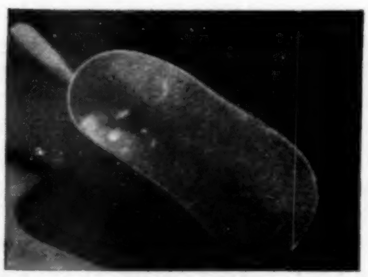
Military applications

Before looking at postwar markets, it might be well to review some of the major military distinctions in the uses of resin and rubber coatings, since the outfitting of the Army and the Navy completely changed the coating industry. In this review it must again be stressed that the choice of coatings for military purposes was guided by availability rather than by a nice assessment of properties. If the coating was satisfactory it was continued—until it was put on priority

The best designs are often found in smaller shops



Plastics coat hook capable of supporting 280-pound weight. Molded by Pyro.



This plastics scoop replaced heavier metal type. Injection molded by Pyro.

Size is not always an index of quality. Designers with relatively small staffs frequently achieve a worldwide reputation for creative excellence.

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Pyro invites inquiries from manufacturers requiring custom moldings for war production . . . for essential civilian goods . . . and for postwar products.

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for more critical war needs. In general, however, certain rough classifications were made.

The bulk of the military coated fabric requirements were for waterproof equipment once coated with crude rubber. Both in the Army and the Navy the most important single item of proof clothing was the raincoat and the numerous variations which the raincoat took—parka and trousers, poncho, "zoot suits," wet weather gear. These were single-texture fabrics (usually coated on both sides) or double-texture fabrics—two layers of cotton-cloth sandwiched together with a layer of resin or rubber. For the Navy, where weight was less important, more double-texture fabrics were used. In the Army weight became increasingly important, and in the last 6 months the standard heavy Army raincoat has been experimentally replaced by large orders of lightweight nylon ponchos (a combination poncho, groundsheet, tent and foxhole cover, a sheet of nylon coated with vinyl resin). Weight is particularly onerous in the heat of the Pacific, and for that reason the Quartermaster has introduced nylon, but the Marines and the Navy still continue the use of a camouflaged double-texture cotton lawn poncho laminated with butyral but also lightweight.

The standard G.I. raincoat is single-texture 3.60 cotton sheeting, heavily coated and waterproof on the inside (usually with one prime and one heavy calender coat, though more coats may be used), and skim-coated and water-repellent on the outside. Vinyl resins are most commonly used for the coating, though buna S and other rubbers have been used when available. The Navy enlisted man's raincoat is double-texture cotton twill outside and cotton lawn inside laminated with polyvinyl butyral or butyl rubber. Crude, neoprene and the vinyl copolymers have been used in the past for the Navy raincoat. In general for proof clothing and equipment where the only requirement is a waterproof surface, any of the generally used military coatings are satisfactory (the alkyd modified oils, the vinyl resins, or the synthetic rubbers).

For certain pneumatic equipment, crude rubber or the synthetic rubbers are always reserved. Crude rubber is always reserved for the crash boats and life rafts carried by the Army and Navy air forces because of the extremely high altitudes (40,000 ft.) at which the planes fly and the extremely low temperatures which the rubber must withstand. Crude rubber is more flexible at low temperatures than any of the synthetic rubbers or resins. Crude rubber is also still used in life vests and divers' suits, though it is said not to be necessary in these uses, and life *preservers* are now vinyl chloride coated with vinyl chloride or the high chloride content copolymers. Crude was once reserved for the large inflatable pontoons and crash boats of the Corps of Engineers, but neoprene was found to be an excellent coating for these boats which, unlike the small boats carried by airplanes, do not encounter low temperatures. (Neoprene is also used for mechanical goods, hose, beltings and packings where its oil resistance is important.) Other pneumatic equipment formerly made of rubber is now coated with polyvinyl butyral or the synthetic rubbers.

For hospital sheeting and sanitary goods, synthetic rubbers are preferred to vinyl coatings because of their softer hand, but the vinyl resins are often used and have the advantage of greater durability. For tents and other miscellaneous items, vinyl resins or the synthetic rubbers can be used, but vinyl resins have been more frequently used because of their readier availability.

For airplane, tank and truck upholstery, and for furniture aboard battleships, vinyl resins have been found to do an even better job than the crude rubber upholstery they replaced because of their long life and better flexibility. They are, of course, compounded to be fireproof.

For the small but vitally important field of chemical warfare, most of the resins and rubbers were tried in turn until butyl became available. It is conceded to be the best in that it gives the maximum of protection with a minimum of coating, and it is the only coating specified today for gas resistance. Neoprene, the alkyds and pyroxylin all were originally tried, but they proved unsatisfactory and were supplanted by polyvinyl butyral. Polyvinyl butyral was used until recently, when it, too, was supplanted by butyl rubber. The famous top-to-toe decontamination suit for workers who clean up after gas attacks is all butyl.

The problem of adhesion

In supplying the new military coatings many problems in fabricating, cements and adhesion arose with both the resins and the synthetic rubbers, but the industry developed a remarkable "show-must-go-on" psychology, and most of the problems were met with one expedient or another. By and large, the expedients improvised were ingenious and successful, but cements and adhesion are still a problem to be worked out with each coating and each fabric. Among fabrics, rayon, nylon and all the synthetic fibers are more difficult to coat than cotton and the natural fibers because of their slippery surface. The nylon ponchos now being ordered are coated with a very light film of vinyl resin, as heavy films were found not to have good adhesion; it is still too early to say whether they will be as durable as previous fabrics. Wool is the easiest of all fabrics to coat, but it is seldom used. Cotton is the next most readily coated fabric, and the most widely used. In general a rough weave is more easily coated than a smoothly woven fabric. But this problem of fabric finishes and of slippage will probably be met in time by special bonding or priming finishes to improve adhesion. Silica sol, for instance, has already been used to prevent slippage in rayon and nylon yarns, and it or similar finishes will come into the coating field.

In the property of adhesion, buna S is one of the most difficult coatings, while butyl and polyvinyl butyral are perhaps the best of all the military coatings. Adhesion of buna S to the fabric is very much improved by an anchor coat, a solution coat which is applied before calendering and which soaks into the interstices of the fabric. Buna S has never been used on nylon, except in experimental coatings.

Cements have been, and remain, a constant problem in fabricating. Crude rubber has a natural cementing quality and, as the proofers say, "cements almost anything." At the beginning of the war, crude was allocated for cementing seams in military garments and neoprene, the next most cementable rubber, for cement for civilian clothes. (No crude is allowed for civilian uses except in druggists' sundries.) Although each laboratory works out its own formulae for cementing, and there is considerable secrecy involved, crude is still generally used where uncoated fabrics are to be cemented, and neoprene cements where neoprene is to be cemented, while for buna S a combination of synthetic rubbers are used and for buna N a buna N cement. None of the rubbers is as satisfactory for cements as crude.

The postwar

Any discussion of the postwar field introduces an element lacking in military planning. Availability, expediency quality—such standards govern a war effort where money is a forgotten commodity, but in civilian life when money again rears its ugly head, price will again be the governing

factor, in coated textiles as in all industry. The scope of the postwar coatings industry will depend on its competitive price; and its price, in turn, will depend on uncertain factors—the quantity of crude and of synthetic rubber available, the state of the European textile industry, and of labor and inflation in our own country—to mention only the more obvious hazards.

In the dangerous business of forecasting the future, therefore, we take cover, like other great crystal gazers, in generalities, predicting only certain dark and blond forms clearly discernible on the horizon, and about to have a great influence on the susceptible nature of the coatings industry. For general-purpose coated fabrics in large volume consumer uses, there is little difference between the various resin and rubber coatings; for waterproof goods such as standard raincoats all are adequate, and the choice will depend on price. Lower priced coatings will capture most of the markets for waterproof goods, and higher priced coatings will be pushed into special markets. While the price of resin coatings will, in all probability, be lower after the war (other anonymous crystal gazers predict that vinyl copolymer resins will drop from their present price of 38 cents to 25 cents a pound), their price future is not fraught with such uncertainties as now threaten the synthetic rubbers. Foremost among the dark figures looming up on the price horizon of rubber coatings are the return of crude and the government program in synthetic rubber. When will crude return and at what price? (Before the war it averaged 21 cents, though it has sold as low as 3 cents a pound.) Will the government continue its present sponsorship and subsidy of synthetic rubber? It is generally supposed that the government will continue its present rubber program and in the proofing industry rumor has it that the price of synthetic rubber, i.e., buna S, will drop to 13 cents a pound. (Present prices of synthetic rubber range from 15 cents for butyl to 18 cents for buna S and 27 cents for neoprene.) Like the present price, this would be an artificial price made possible through subsidy.

Much hinges on the return of crude. Not only do traditional proofers prefer crude, but its return would immediately release large quantities of the synthetics from the tire and other markets where, although synthetics are gaining ground, crude is still preferred. It would dump quantities of synthetics on the market. In unravelling the skein of crude rubber and the enigma of its future, a storm of rumors darkens the crystal. It is said that crude will appear in quantities as soon as the war ends—that, in fact, we are even now buying crude from Japan via Russia; it is also said that we will not have crude for years to come because the Japanese will destroy the plantations which they now hold before they retreat from the area.

In the storm of rumors one or two probabilities stand out in bold relief. The first is that neither the Japanese nor the natives will concern themselves very much with rubber culture during the Pacific campaigns, and as the plantations need constant care, they will suffer some small damage through neglect. The second is that, whatever the intentions of the Japanese (and despite the fact that they have already destroyed some plantations), war is an untidy art full of loose ends, and the Japanese will find it troublesome to destroy the plantations in the course of a retreat. Even where the burnt earth policy has been followed at its most drastic, this war has shown the resilience and recuperative powers of industry and nature. Though it may be several years before the plantations reach their maximum production, it appears certain that we shall have some supplies of crude within a year after the war.

Another enigma on the horizon of crude is washing facilities. In the old days when our rubber came from South America, it was the Latin custom to wrap stones, dirt and dead monkies with the rubber to increase the weight, and our plants then had elaborate washing equipment. With the shift of our rubber supplies to Malaya and the East, our plants scrapped their washing equipment, as the Malayan rubber comes in already washed and refined. The processing plants there are said to have been destroyed in the Japanese advance, and washing may be then, an immediate, if temporary, bottleneck for crude supplies.

Regardless altogether of the future of crude rubber, if the government continues its paternal sponsorship of synthetic rubber, the price of synthetic rubber will almost certainly be lower than the prices of vinyl and other resin coatings. Regardless of properties, buna S will almost certainly be the most used synthetic rubber for coating because the manufacturing facilities for buna S are greater and the government investment in plant will continue to make it the most available. Buna S and film—unsupported plastic film of all types—are the dark competitors on the price horizon of the vinyl resins. The differential between the prices of the vinyl resins and the rubbers is not so great as it appears since the resins can be loaded in compounding to be much cheaper than the resin price. Even at their present price of 38 cents a pound vinyl copolymer resins will certainly dominate many markets because of their abrasion resistance and the wide range of coatings they make possible. Their oil resistance, too, will put them into some cheaper markets, such as truck upholstery.

With these cryptic words on the subject of price, we leave the reader to unravel the skein of prophecy and interpret the omens as he will, and we rush on to more tangible fields of prophecy where the past is a reliable guide to the future.

Though the history of textile coatings during the war is the story of vinyl resins and the synthetic rubbers, other resin coatings which were not used during the war either because they were allocated to other industries or because their properties were not the best suited for military fabrics, will return to their prewar markets. Among the cellulose derivatives, cellulose acetate has an established market in collar interlinings and thermoplastic labels and in a few heat-sealing uses. Ethyl cellulose was just getting into large production as a textile coating when the war allocated it for other purposes. It was used in such household textiles as glazed chintz, but half of its entire production went into coating cotton duck for tents. In the war it has been used for military tents and paulins. It is a lightweight coating, well suited for camp equipment, and is tough and flexible. It can be used with cheap solvents and compounded with other resins to give special properties; in combination with cellulose nitrate, it gives excellent flex and wear resistance without the problems of exudation of plasticizers at high temperatures.

Largest in volume and importance of the cellulose coatings are the pyroxylin coatings. While vinyl resin coatings have had a more spectacular war development, pyroxylin has maintained its place in consumer civilian goods, and pyroxylin coatings today are close to 90 percent of their prewar volume. With the advantages which combinations with other resins will give, pyroxylin will probably extend its markets after the war and dominate the low-priced field of resin coatings where the higher priced vinyl resins cannot compete. It will remain as the artificial leather of cheap upholstery, pocketbooks and novelties, where price and bright colors are more important than durability, and as the glazed and

coated fabrics which are used in bookbindings and household accessories.

Acrylic resin coatings, which, during the war, made luminescent tapes for blackout guides, will reappear in protective or transparent fabric coatings, in rainwear, and shoe fabrics.

The upholstery market which was divided before the war between pyroxylin and crude rubber will have new competitors after the war. For automotive and heavy-duty upholstery both vinyl resins and synthetic rubbers will be used. The rubbers, having the advantage of lower price, will be used in dark colors for bus and truck upholstery and institution furniture, while the resins, having greater resistance to flexing and better wear and color range, will dominate the higher priced upholstery market (though even here there are those who say that unsupported plastic film, the dark horse on the horizon of the coated textile industry, will compete).

Film will compete, too, in another large market for lighter weight coated fabrics—raincoats, shower curtains, bath goods, infants' wear and lingerie cases. Here again the resin coatings may be expected to control the higher priced quality field where the superior wear and colors of the vinyl coatings are important; but in the lower price ranges it will be a free-for-all market in which film-, oil- and rubber-coated fabrics will compete, and price will be a determining factor.

Heavier weight raincoats will also be a mixed market. The alkyd-modified oil coatings now used by the Navy in storm weather suits will fulfill similar uses in cheap raincoats for fishermen, workmen, and in meatpackers' aprons. The principal asset of the alkyds is to modify the oil coating, which still has the disadvantage of stiffening at low temperatures and sticking at high temperatures. Better quality heavy raincoats will be made, like the Navy raincoat, of double-texture fabrics laminated with polyvinyl butyral or butyl rubber. Double textures will come into increasing use for such durable fabrics as policemen's coats, firemen's uniforms and laborers' clothing.

In the shoe market, vinyl resin, synthetic and crude rubber coatings will compete, though here the superior flexibility, abrasion resistance and wear of the vinyl resins should determine the market. Vinyl coatings should capture the patent leather market now held by pyroxylin ("patent leather" being actually pyroxylin-coated cloth), as their wear and scuff resistance is very much greater.

Surprisingly enough, tablecloths are a large market for coated fabrics, and a disputed one. Oil being still the cheapest of all the coatings, the bulk of all tablecloths will be the famous oilcloth, but pyroxylin will compete in the market, and polyvinyl butyral expects to find a quality market in the coating of table linen to eliminate washing problems.[4]

Synthetic and crude rubbers should control the market for sanitary goods and hospital supplies because of their lower price and their softer hand, but in such uses as sanitary gloves where durability is the criterion, vinyl resins will compete.

The superior qualities of these new coated textiles will greatly enhance the scope of their postwar markets. Because of our long association with dark and cumbersome rubber-coated fabrics of prewar days, it is hard to imagine the versatility and beauty of the new coated fabrics. One can best describe them, perhaps, by saying that they are invisible except for the slight glaze they add to the fabric (and unlike the glaze on our old chintz, it is a permanent glaze). Unlike the old rubber coatings, too, they are lightweight and flexible. They come in all colors and degrees of transparency, and to an ordinary print they add a shell-like transparency. These new coated textiles will go into new markets—into sporting goods and household goods and even into drawingroom curtains where invisible coatings can avoid laundering and can be cleaned with a sponge.

Despite the prejudice against coated fabrics in shoes because of the fact that coated fabric does not breathe, there will be some extension of their use in shoes—in slipper soles and trimmings, and vinyl shoe fabrics. It is thought, too, that the leather shortage will continue, particularly in Europe, and that coated fabric shoes will be exported in quantities to Europe where popular taste is less discriminating in the comforts of life and shoe fabrics.

Double-texture and plied fabrics, also, are an important new market which the war has opened up, and which will go into consumer and industrial uses.

Combinations of resins and synthetic rubbers, hitherto not possible in the war exigency, will open up still other markets. But perhaps the most cogent asset of the new textile coatings is that they are no longer just "waterproof goods"; they are proof against whatever is needed and are tailor-made to specifications, like the special process yarn coatings[1] which served during the war as fluorescent yarns for blackouts, and—more recently—as an x-rayable yarn for the human body that will not injure internal tissues.

Acknowledgments

Modern Plastics wishes to acknowledge a special debt of gratitude to James R. Owens of E. I. du Pont de Nemours & Co., Inc., who was, until recently, with the Office of the Quartermaster General in Washington in their coated fabrics clothing division. Thanks are also due to C. W. Patton of the Carbide and Carbon Chemicals Corp., to officials of the Monsanto Chemical Co., the B. F. Goodrich Co., and the Goodyear Tire and Rubber Co., as well as to the Office of the Quartermaster General, and to many executives in the coating and proofing industry who generously assisted in the preparation of this material.

Unnotched impact strength

(Continued from page 153)

For purposes of analysis, the data in Table II (See page 154) have been placed in the order of increasing volume of the specimens. Equation (1) can be written:

$$W = a + bV + cV\frac{d^2}{l^2} \qquad \text{(Equation 2)}$$

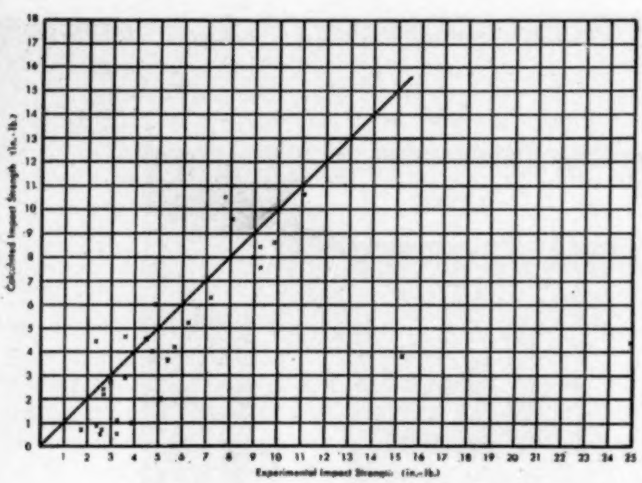
In this equation a was inserted to account for any losses of energy that might occur during the impact due to deformation of the sample or poor transfer of energy to the specimen. The constants of Equation (2) for the data in Table II, which appears on page 154, were found to be: $a = 0.0$, $b = 12.7$ and $c = 223.5$. The experimentally determined equation would therefore be:

$$W = 12.7V\left(l + 17.6\frac{d^2}{l^2}\right) \qquad \text{(Equation 3)}$$

From this equation the energy W can be calculated and compared with the experimentally determined energy, W_e. These data, given also in Table II, fit the equation to within an average error of 20 percent.

Calculations of the second term of the equation above revealed that for many cases the energy due to shear was below

[4] Plexon yarns will also go into tablecloths.



1—***Comparison of the calculated versus the experimentally determined impact strength of allyl type resins***

10 percent of the total energy required to break the sample. Ignoring this term for such cases, Equation (1) reverts to:

$$W = \frac{\rho_m^2}{18E} V \text{ or } \frac{\rho_m^2}{E} = \frac{18W}{V} \qquad \text{(Equation 4)}$$

For the data given in Table I, where the second term is below 10 percent of the total energy, the constant ρ_m^2/E averages 258 p.s.i. This would indicate a flexural strength of 8000 p.s.i. and a modulus of 250,000 p.s.i. This figure was, in fact, the expected average for the resin being tested—cast Allymer C.R. 39. However, no actual flexural tests were run on duplicate specimens.

Calculation of impact strength from flexural data

A large amount of flexural data was available on allyl type resins and impact strengths were calculated from these data, assuming that shear forces were not prominent. These values are compared in Fig. 1 with the experimentally determined values as obtained on the pendulum-type impact tester. It will be noticed that the agreement is good. Certain materials of low modulus and thermoplastic materials did not fall near the theoretical line.

In order that the ideas developed herein could be more closely checked, sheets of resin were cut into specimens of such length, width and depth that the shear forces would be negligible, and tests were run on them for both flexural and impact strength. In both tests the same anvils and the same tool for applying the load were used. The data given in Table I for several resins show remarkably good agreement, except again for the thermoplastic materials. The anomalous behavior of the thermoplastic materials on the few tests made was probably due to plastic flow which occurred during the flexure test.

Conclusions and acknowledgments

It is evident that the theoretical equations of impact are followed within reasonable limits.

The length of span necessary for pure bending can be determined by an inspection of the second term of Equation (3).

Impact on unnotched bars can be calculated from the flexural data for most thermosetting materials of the Allymer type, but not for thermoplastics.

Acknowledgment

The author wishes to acknowledge the assistance of Mrs. Cleona Paden, who carried out the experimental work.

Phenolic casting resin

(*Continued from page 133*) importance, and it should be low if the air bubbles are to be removed with ease. Too rapid cure may also cause trouble in the effort to prevent air bubbles from being entrapped in the material due to the fact that the mass solidifies before all the air has had time to rise. By placing the mass in the oven somewhat sooner than is usual, the air is more readily removed and satisfactory castings are obtained. However, this procedure can be rather risky and may cause the reaction to proceed at too rapid a rate. In extreme cases, this procedure may result in a so-called "gone over" valueless mass.

Preparation of molds

While most tool men are quite familiar with the preparation of molds for casting purposes, it should be emphasized nevertheless that phenolic resins adhere very strongly to plaster and wood surfaces. Therefore, if the mold is to be used again, some means must be adopted to overcome this tendency. Otherwise the only means of removing the casting will be by breaking the mold. It has been found that the simple expedient of coating the mold with from four to six coats of a good lacquer and allowing them to air dry thoroughly, or better still, giving the last two coats an oven bake followed by an application of a very thin film of mineral oil, will form a smooth surface from which the casting can readily be removed.

Summary

When the findings described above are incorporated in the preparation of the casting, the phenolic resins, such as G. E. 1420, produce very satisfactory stretching dies, forming blocks, drill jigs and gage blocks at a considerable saving in time as compared to methods previously in use. It has now become possible to contemplate the production of finished tools in hours instead of days or weeks. A good average of the physical properties of the products so produced is given in Table IV using walnut flour D-40 in one type and Celite in another. It should be noted that when Celite is used machinability is poor.

While this type of plastics has found its immediate application primarily in the aircraft industry, there seems to be no doubt that as its properties and characteristic casting speed

TABLE IV.—AVERAGE PROPERTIES OF G. E. 1420

Filler	*Walnut flour*	*Celite*
Compressive strength, p.s.i.	8000	10,000
Flexural strength, p.s.i.	3000	5000
Tensile strength, p.s.i.	1500	1575
Shear strength, p.s.i.	3000	2410
Impact strength, ft. lb./in. of notch	0.25	0.27
Specific gravity	1.15	1.38
Shrinkage, in./in.	7×10^{-3}	4×10^{-3}
Thermal expansion, in./in./° C.	4×10^{-5}	4.35×10^{-5}
Heat resistance	Not above 125° C.	Up to 150° C.
Effect of aging	None except change in color	None except change in color
Machinability	Good	Fair (dulls tools quickly)
Specific volume, cu. in./lb.	24	20

become better known, it will find numerous applications in other industries—in the production of models, sample molds and other devices which can be made easily and quickly. The future prospects for this material seem to hold forth considerable promise.

Emphasis on beauty

(*Continued fram page 111*) to such magazines as Harper's Bazaar, Mademoiselle and Vogue. On at least one occasion art students were asked for their ideas on hair ornaments. The designs suggested by several in this group later proved their popularity in both the quality and the mass markets.

Experience—the company was founded in 1923—has shown that hair accessories tend to move in cycles. Recently Spanish combs have reasserted their popularity after a lapse of several years. Brilliant-studded barrettes are even now appearing about town. It is anticipated that the plain sisters of these barrettes are due for a comeback. This prediction is based partly on the realization that the bejeweled items of this type are not appropriate for every occasion.

The how and where of selling

While the model heads serve to tell the ultimate consumer where and how these plastic accessories, whether handmade or injection molded, should be worn for maximum effectiveness, the company faced the problem of instructing the retailer in these selfsame questions—Where and How should the combs be displayed? With almost 90 percent of its business coming in through the mails, this manufacturer of hair accessories found that its plastic hair ornaments were too often lost among other jewelry or novelty items.

To assure maximum promotion of its products the company now suggests that the stores handling its hair goods set up "Glamour Bars." For the most part these consist of an end counter section where hair ornaments, fancy combs, shell hairpins, bows and related items can be displayed in a glass case on top of the showcase or in open display boxes. In the showcases immediately below or, perhaps, in glass-fronted cases behind the counter, model heads and photographs of models with varied hair styles illustrate the different uses to which these plastic accessories can be put. This manufacturer makes a practice of sending out leaflets picturing successful "Glamour Bars" in use throughout the country. This instruction is supplemented by photographs of models wearing various types of plastic hair goods and, upon occasion, models are supplied upon which sales girls can demonstrate the latest in combs and barrettes to interested customers.

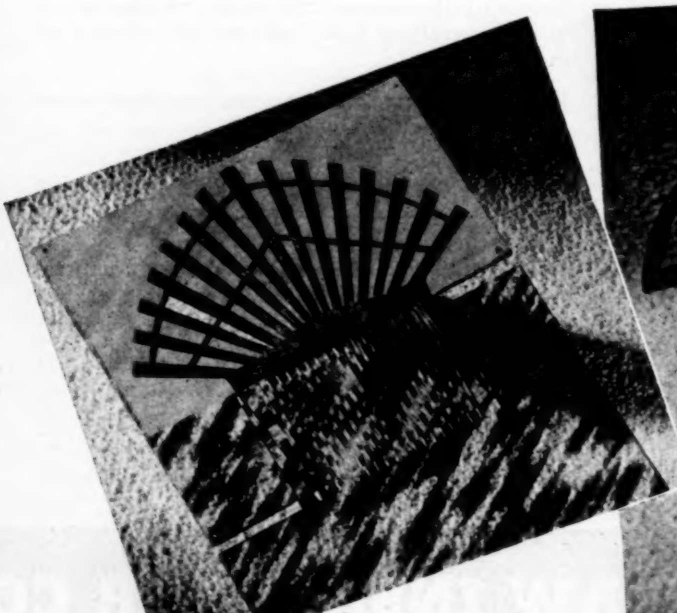
According to reports, buyers in the Hair Goods Section of department stores are firmly convinced that these "Bars" do a wonderful job in suggestion selling. Almost invariably the average customer makes at least one additional impulse purchase while buying the specific article that brought her to the department—sales that would have been lost if the hair accessories had not been emphasized by concentration in a single well-lighted display.

Just as resourceful is this company's merchandising of its standard utility combs. At one time department stores carried but a few styles which usually cost in the neighborhood of 50 cents or a dollar. If the customer wanted a less expensive comb, the store was content to let her go to the syndicate store. It was the feeling of the comb manufacturer that every time the housewife was thus forced to shop in the lower priced stores she bought a few additional items. Thus the department store lost much more than the initial 10 cent comb sale. To combat this trend, general merchandise stores are being urged to carry a full line of combs of all types priced at 10, 25, 50 cents and a dollar.

Handmade versus molded products

The procedure followed by this manufacturer of hair ornaments is first to make the product by hand—cutting it out of plastic sheet material and decorating it with brilliants or

Typical of the ingenuity that goes into the designing of these hair ornaments is the swivel joint on this Spanish-type comb. With this construction it is no longer necessary to remove the comb again and again to get the fan at the right angle. Another new development is the initialing of barrettes which are intended to be worn in pairs



simple carving. After a lapse of from 6 to 8 months the more popular of these expensive accessories are redesigned so that they can be injection molded at a considerable saving in cost. For example, a transparent Spanish-type comb decorated with rhinestones usually sells for about 10 dollars when handmade from flat sheets of plastic. A similar comb is now being molded of acetate material. Minus all decorations, this comb will sell in the syndicate stores for 25 cents. When inset with brilliants the injection-molded article will retail for one dollar.

Comparative figures on the sales of handmade and molded articles are difficult to ascertain. In the case of a simple bow-shaped barrette the ratio between molded and handmade pieces was 25 to 1. The figure sometimes runs to 1000 to 1. And still upsets occur. A comparison of the sales figures of two "rats," one selling at 59 cents and the other at 20 cents, showed that the more expensive item had sold 1000 to 1 of the cheaper article.

Even now the company is making plans for the postwar. Already well represented in most of the large cities of Latin America, it hopes to extend its coverage in all parts of the world. And to mark the day when such plans can take on substance, a V-Day hair ornament is already in production.

A miniature cruiser

(*Continued from page 105*) these, of course, produce more than one part—three different-sized gun barrels are included in one die, for example. Then, many parts are duplicated, such as ladders and sections of the rail. Even with these provisions, however, there are a number of single-cavity dies, including those needed for the larger hull and deck sections.

Steel dies, of course, were out of the question since it was estimated that it would take five average die shops nearly a year to do the complete job. It was decided to use bronze dies, which would be satisfactory for the comparatively short run. Moreover, a dull finish instead of high finish, possible with bronze dies, was in accordance with Navy specifications.

The first step was to make a complete and precisely scaled wooden model of each part. Plaster casts were made from the wood, and these were sent to a brass foundry for casting the bronze dies. Chasing, finishing and mounting were done by the molder—in itself an unusual procedure. All told, nearly six months were required to make the dies despite the short cuts that were taken.

Once the dies were completed, the actual molding of the

OFFICIAL U. S. NAVY PHOTOGRAPH 7

8 OFFICIAL U. S. NAVY PHOTOGRAPH

7—In another training method these ship models are set out on a flat surface where they can be moved about to demonstrate tactical maneuvers and other phases of training. 8—This photograph of actual cruisers illustrates how well the method shown in Fig. 6 creates the illusion of distance at which real ships are usually viewed

various parts was accomplished without delay, but assembly operations at first were comparatively slow because of the complicated nature of the job, and the need for thorough workmanship and expert cementing. That this was accomplished is shown by the fact that there has been little damage to the models in shipping. Any of the models can be placed on end and handled frequently without danger of parts becoming dislodged or falling off.

From the standpoint of usage and value to the Navy, the plastic models have two big advantages over the wooden models. The first is the completeness of detail, and the second is that all models produced are exactly the same, making it possible for all trainees to get precisely the same instruction. Many of the details of the wooden models, formerly used, were regarded as crude, and moreover many parts, including superstructure details were missing.

In cost, the plastic models are substantially lower than the average for the wooden models, even including the amortization of the tools and dies. It is estimated that each of the plastic ships has a value of approximately $500. As soon as Navy requirements have been filled, the molder plans to offer the ships for civilian sale, official permission having been granted. So far, approximately 100 models have been produced. A rate of 10 per week was reached on the assembly line in the late months of 1944.

Credits—Material: Lumarith. Molded by Livingston Plastics Corp., for Training Aids Div., Bureau of Naval Personnel, Navy Dept.

Precision instrument

(*Continued from page 113*) into place, they are there to stay and nothing that happens to the instrument in use must cause them to slip or weave. The end piece shown in Fig. 1 is assembled with the third molded part, the prism holder tray.

This end piece which holds the metal shank at one end, and the mirror assembly at the other, is molded oversize be-

Maybe you don't need any help

in planning your molded plastics job!

MAYBE you're one of the few who employ men with years of experience in designing for molded plastics . . . men who know molds and mold-making . . . who know from experience not only the characteristics of the various molding materials but how they behave in the molding process . . . who understand the different molding processes and the advantages of each. If you are one of these few, perhaps you don't need any help from your custom molder.

But . . . such a situation is rare. That's why we maintain a staff of engineers whose job it is to work with CMPC customers and prospective customers. These men have had years of experience in all phases of plastics molding. They can tell you quickly whether yours is a practical application for plastics. They will work closely with you in matters of design and selection of the proper molding material. They can give you unbiased advice as to the best method of molding your part for we have complete facilities for all three commercially important methods . . . compression, injection, and transfer molding. In other words, here is a board of plastics experts ready to serve you.

To get the most out of such assistance, ask for the services of a CMPC Development Engineer during the early stages of your planning . . . even though your idea may be only a rough sketch on a scratch pad. And . . your request incurs no obligation.

* * *

Here are a few points worth remembering:
*CMPC operates the largest, best equipped custom molding plant in the Middle West . . . *Offers a complete service—designing, mold-making, molding, and finishing—all within its own organization . . . *Is backed by more than a quarter century of experience in plastics . . . *And has a nation-wide reputation for quality—for doing even the toughest jobs well.

We've been at it for over 25 years

CHICAGO MOLDED PRODUCTS CORPORATION

1046 N. Kolmar Ave. Chicago 51, Illinois

COMPRESSION, INJECTION, AND TRANSFER MOLDING OF ALL PLASTIC MATERIALS

cause there are thick and thin walls and the bottom end shrinks more than the upper end which is held stable by the molded-in metal shank. Several changes were necessary before this part behaved as it should.

The castings are filled from a very small gate and, due to the design and construction of the mold, no bond line shows on any of the pieces. Holders were inserted in the mold for the metal parts and the cores are removed by hand. These holders were necessary because the two metal parts—one in the end piece and the other in the "Y"-shaped part (the fourth molded piece) have to be in line since they constitute the mechanism for adjustment in the eye piece. These two metal parts may be seen in the illustration (Fig. 3). One is the metal shank which fits into a drill chuck or collet when the device is used. The other is a metal insert tube at the bottom which guides and supports the objective lens mount.

The molded "Y"-shaped piece is gated near the end of the longest member and the material flows in such a direction throughout the cavity that no bonding lines appear. There is a great variation in wall thickness throughout the two larger moldings and a number of engineering tricks were worked out to prevent uneven shrinkages which might interfere with the precise operation of the device.

The molder points out that where 6 leader pins, approximately $^3/_4$ in., are commonly used to hold dies in alignment during molding, in this mold 6 pins, 1 in. in diameter, are used. This arrangement of pins eliminated any possible movement of the die.

A hard-flow cellulose acetate butyrate material is used because it shows less tendency to respond to any temperature changes the center scope may encounter in use. The four pieces weigh approximately $3^1/_2$ oz., exclusive of metal inserts, and are cast in one die on an 8-oz. injection machine. The fact that a gray material was available pleased the manufacturers because the devices had been previously enameled in the exact shade now being used in plastics material. The old and the new placed side by side appear alike. But the plastic doesn't fade or chip and when it gets greasy and soiled, it is easily cleaned.

Now that the transition is complete and the new plastics center scope is on the market, the company has been notified by WPB that the use of aluminum in the official field of machine tools equipment, parts and accessories, is now permitted. Asked if they would return to aluminum now that it is available, Mr. Griffin grinned: "There is still a manpower shortage, or haven't you heard?"

Credits—Material: Tenite II. Molded by Modern Plastics Co. for Center Scope Products, Inc.

Canada in postwar years

(Continued from page 109) reactions to plastics' excellent war record is the increased interest of Canadian industrialists and industrial designers in these materials. The fine precision work which has been achieved in the production of many intricate and complex articles of war from molding materials could not help but attract their attention. The high state of development of the synthetic rubbers also promises a new and valuable market for this division of the industry. Extruded materials for cable and wire coverings and for other applications in the electrical and communication industries, will be in great demand in the postwar period. The builder will be another new peacetime customer as will the food processor, brewer and chemist. Perhaps the No. 1 customer for the plastics fabricator will be the automotive industry with its need for seat coverings, safety glass, and numerous knobs, handles, and other gadgets.

Thus it would appear that the young plastics industry in Canada need have no fear of the competition and race for markets which will come with peace. The story of the Canadian industry is one of an infant that grew to maturity almost overnight and steadily added to its engineering skill, fabricating knowledge and manufacturing integrity under the stern demands of war. Any industry which can start from scratch and achieve what the Canadian plastics industry has done in the past 5 years should have little difficulty avoiding the commercial pitfalls and as yet unforeseen problems that will come with the postwar era.

Raw material availability

(Continued from page 124)

Phenolic molding powder

This material is getting tighter and tighter, with the January supply a little more restricted than December's—the month when the pressure was first applied. The phenolics, of course, are affected by two shortages—phenol and formaldehyde. Civilian production was severely curtailed in January and items such as automotive ignition parts, agricultural supplies, office machine replacement parts, safety equipment and other very high essential civilian items will receive only about 50 percent of their requests, as compared to 85 and 65 percent last December. Textile and rayon equipment, which received 100 percent in December, was allocated the same in January because of its high importance to the military effort at the present moment.

All items on the spot program such as electric iron handles, vacuum cleaner and refrigerator parts, were denied in January and perhaps will be for several months to come. Radio cabinets, handles for safety razors, lipstick containers, ash trays, poker chip boxes, letter trays, globe bases and inkwell bases are practically all due for a zero allocation that may last for several months. There may be changes from month to month, such as in kitchen utensil handles, which were denied in December but received a very small allocation in January. There are variable factors controlling such allocations, but whenever one is granted to an item such as this, investigation shows that it is in very small quantity.

Officials have let it be known that they have denied all phenolic closures and buttons and have requested that the molder use urea for these articles when he is able to get it from his materials supplier.

Phenolics for laminators

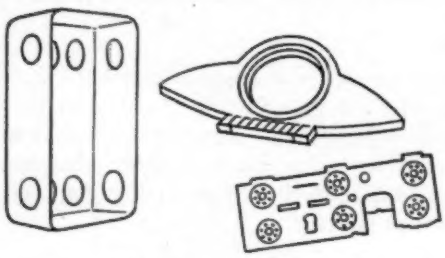
Laminators are engaged almost 100 percent on military or highest essential items. They have a great many rejects of material delivered to subcontractors making Army or Navy items, but the rejects go right back into highest civilian uses—into insulation parts, mechanical and structural uses, safety helmets and similar articles. A small amount for fluorescent lamp bases was questioned by this observer, only to find that fluorescent lamps are only allowed for war industries so there is not much question in making such an allocation. Consequently, every effort will be made to supply laminators with phenolic resin, and when cuts are made they will be slight compared to the cuts made in other fields. All decorative laminate, even including that which is intended for hospitals, has been denied. *(Please turn to page 198)*

How to specify plastics for meters, scales and control instruments

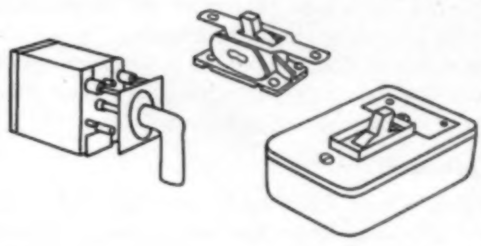
In designing your measuring devices, you'll want to specify the plastic that will give you the fullest measure of advantage, in each particular use.

Many new plastics and new qualities in former plastics have been developed and proved in war service. There's no reason why you shouldn't make the best possible use of these new materials and new qualities now in war applications and later in normal production.

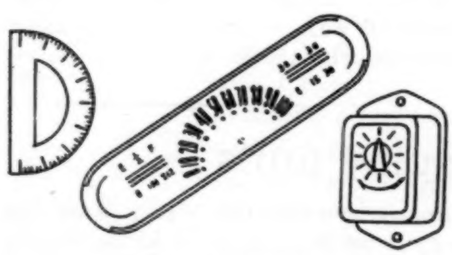
Perhaps the indicators in this advertisement will help in making selections for general applications. For complete information on any of these, or other plastics, contact the plastics consultants of Monsanto, producer of the widest variety of plastics in the industry, and the source of unbiased and experienced counsel on which kind of plastic to use in which spot. Write, wire or phone: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts.



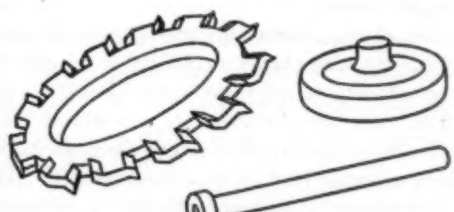
HOUSINGS, PANELS, BEZYLS
Molded Resinox, Fibestos, Lustron, Cerex, Resimene, or Thalid impression moldings.



CONTROLS, KNOBS, INDICATORS
Molded Lustron, Nitron, Resinox, Fibestos



DIALS, CRYSTALS, ETC.
Printed — Fibestos or Nitron Sheets
Molded Scales — Lustron
Crystals—Molded Lustron, Fibestos Sheets



FUNCTIONAL PARTS
Insulating Parts—Styramic HT, Resinox, Cerex
Mechanical Parts—Molded Resinox, Resimene; Laminated Resinox, Resimene

The broad and versatile Family of Monsanto Plastics includes: Lustron polystyrenes • Cerex heat resistant thermoplastics Vinyl acetals • Nitron cellulose nitrates • Fibestos cellulose acetates • Resinox phenolics • Thalid for Impression Molding Resimene melamines. Forms in which they are supplied include: Sheets • Rods • Tubes • Molding Compounds • Industrial Resins • Coating Compounds • Vuepak rigid, transparent packaging materials.

MONSANTO
PLASTICS
SERVING INDUSTRY...WHICH SERVES MANKIND

Urea resin

This material is extremely difficult to predict because it is so variable and so dependent upon a multitude of factors. First, urea takes more formaldehyde than phenol, and urea resins are not so completely tied to the war program although they do carry a heavy load, particularly in adhesives. It is also important to keep the producers in operation on at least a minimum scale because a shutdown would result in permanent loss of many key workers and result in loss of necessary military items made of urea or melamine. Furthermore, the allocation of molding powder is handled under Paragraph (*f*), which makes it possible for the producers to distribute some well-defined items in limited quantities to customers as they see fit. There may be a very few highest essential items, such as industrial wiring devices, hearing aids and ignition parts that will get 100 percent, but the total allocation to these items would be small. Even most essential articles, such as stove hardware, clock cases, scale housing, civilian wiring devices, thermos caps and medicinal inhalers, will be cut from 50 to 90 percent. There will be a limited amount of this plastic for buttons, closures and cosmetic containers. Such things as dishware, which includes sieves, funnels, salt and pepper containers, office equipment, wheels and even dinnerware for hospitals and institutions, have been denied, and there is not much hope that there will be urea molding powder for these purposes in the near future. As an example of WPB officials' thinking, it should be noted that even though dishware for hospitals may sound important they point out that crockery or other materials are available.

Urea for adhesives

WPB officials have let it be known that their policy in January for allocating other than urea resins on Schedule 34 (which does *not* include coatings) will be to grant 100 percent for military requests. They will grant 75 percent of normal usage for textiles and woodworking. Normal usage will be determined by going back to normal consumption early last fall or late last summer. Requests for exports will not be allowed except for Lend-Lease. WPB has also reduced the small order exemption from the 2000 lb. allowed in December to 550 pounds. Before the formaldehyde shortage this exemption was 10,000 pounds.

The term "normal usage for woodworking" was defined by an official as meaning such things as civilian furniture, store fixtures, kitchen cabinets, tennis rackets, burial caskets, cedar chests, office files, beer barrel staves, etc. It would also include plywood. There was an error in the December allocation report which reported that all urea specialties for civilian uses were cut 75 percent. The correct figure was 25 percent. Approximately the same cut was enforced in January and allocations will probably continue on that basis for several months unless some military or production catastrophe overtakes us. At the present moment there is slight chance that any more methanol will be made available with which to make more formaldehyde for more urea. There is even a slight chance that urea crystal may be diverted to other uses although the amount used by the plastics industry is small.

Latest reports on urea and melamine resins indicate that production before the current shortage of formaldehyde was running about 3,000,000 lb. a month for molding powder; 7,000,000 lb. for adhesives, textiles and specialties; and approximately 800,000 lb. for coatings.

Cellulose nitrate

Cellulose nitrate production was running about 2,500,000 lb. early in 1944 and had dropped to approximately 1,250,000 lb. in December. The drop was caused largely by a shortage of synthetic camphor and varies with different firms according to the degree with which they extend their present camphor supply. The Army is still using large quantities of cellulose nitrate for such things as side curtains on vehicles, flare containers, parts for mines, and such personal items as toothbrushes, spectacle frames, ping-pong balls, pens and pencils. The greatest civilian production today is in these same personal items plus such things as tool handles, wooden shoe heel covers and office equipment. It is not expected that the nitrate supply picture will change until the large shipments of synthetic camphor going abroad on Lend-Lease for war usage are curtailed.

Vulcanized fibre

This is one of the better spots in the picture. The vulcanized fibre tube manufacturers have practically caught up with the Navy's demand for fuzes and they may be available to handle work in other essential uses during the first quarter of this year. Vulcanized fibre sheeting is in reasonably free supply—that is, manufacturers have less than an 8 to 10 weeks' backlog in orders. It is believed that vulcanized fibre will soon go under order M-340 which will place it with those materials not under control but in which the manufacturer must produce military orders ahead of civilian orders.

Vinyl

There has been considerable improvement in various vinyl resins over the past few months, due largely to fluctuating military requirements. The picture looks better for the first quarter than is the case with most other plastics, with increasing amounts allowed under Paragraph (*f*) for end uses, other than military.

Acrylic, polystyrene, polyethylene, ethyl cellulose

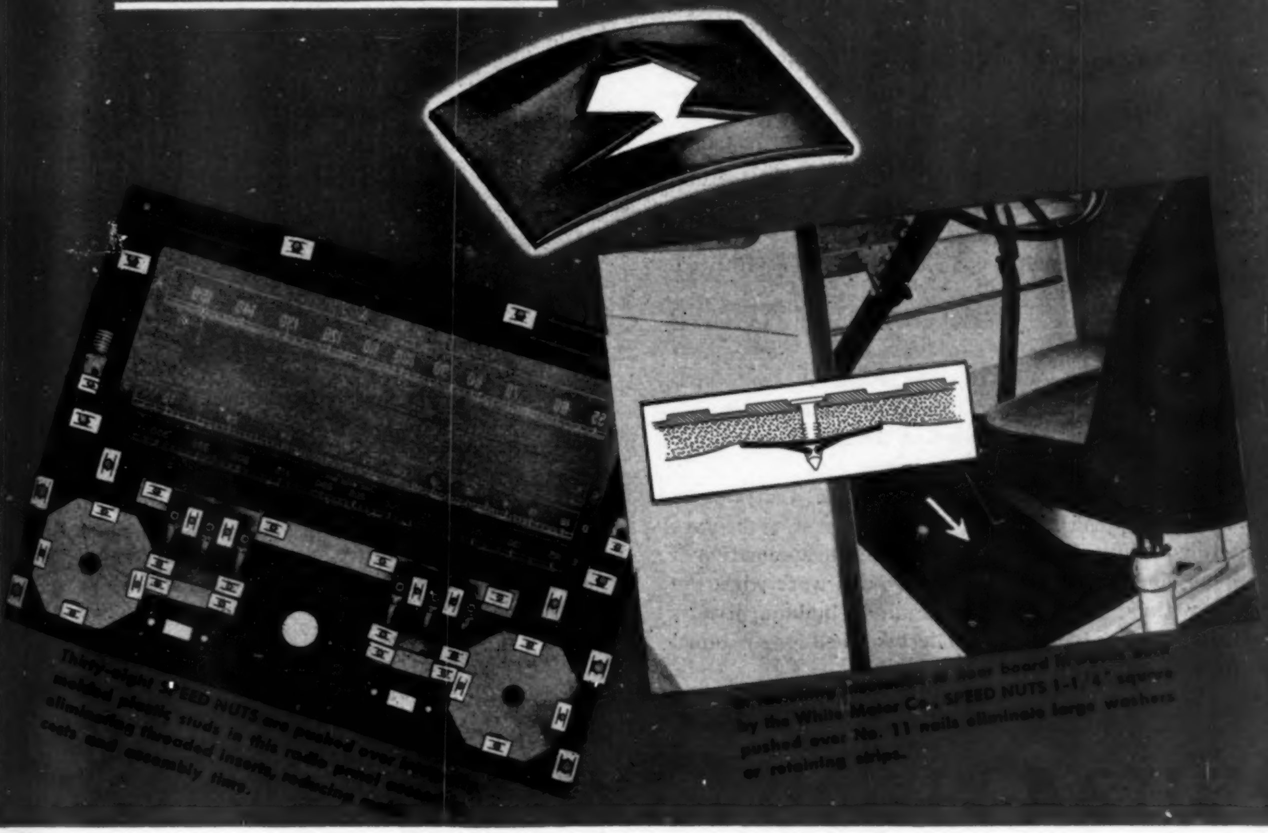
There is very little of any of these materials available for civilian use. Now and then, for various reasons, small quantities are released but scarcely enough to make a dent in the civilian supply picture. Scrap, of course, is available and frequently finds its way into such things as picture frames, pocketbooks and advertising novelties. Its appearance raises complaints, but officials assert that such processing has not yet interfered with the war production and the materials processed are not usable for war purposes.

Display units

(*Continued from page 107*) Fig. 2 would make the entire unit easy to handle, so plywoods for the false ceiling in Fig. 1 and for the separate display panels in Fig. 4 would make these department sections simple to expand or contract at will.

The use of space has also been approached from another angle in most of these displays. Instead of showing only a few samples of merchandise and secreting all the rest in wooden-faced drawers behind the counter or in unrecognizable stacks beyond the reach of buyer and seller alike, these designers have bent every effort to show all salable articles. In the island bag display (Fig. 3) a few purses are featured on the end shelves and the other available models arranged on the center shelves so that customers can see the complete line without recourse to the sales girl. Much the same principle underlies the sectional display shown in Fig. 4. By following an arrangement such as this, stores could give the customer a general idea of its line of slips, pajamas and blouses without consuming the time of any of its help. Today most mer-

THE NUT THAT *Locks* ON UNTHREADED STUDS!



Thirty-eight SPEED NUTS are pushed over integral molded plastic studs in this radio panel assembly, eliminating threaded inserts, reducing [illegible] costs and assembly time.

[illegible] by the White Motor Co., SPEED NUTS 1-1/4" square pushed over No. 11 nails eliminate large washers or retaining strips.

THE BASIC PRINCIPLE
of Spring-Tension Lock is embodied in all Speed Nut Designs

● **Just a push and it locks! It's just as simple and easy as that! For this unique spring steel fastener needs only to be *pushed* over rivets, nails, tubing, wire, integral die cast or plastic studs to lock parts firmly together. Threads are unnecessary because the spring prongs of the nut provide a friction *lock* on even the smoothest of chrome surfaces.**

But easy attachment is not the only advantage gained by using Push-On type SPEED NUTS. Costly threaded inserts, drilling and tapping are eliminated—molding costs reduced—assembly speeded up—and vibration loosening prevented. These fasteners are available in many sizes and shapes . . . rectangular, square, round, or they may be specially designed to fit your particular requirements.

If you want to improve the attachment of name plates, emblems, trim strips, grilles, or other light-weight parts, write now for samples of Push-On type SPEED NUTS, giving *stud diameter* and any other pertinent assembly details.

TINNERMAN PRODUCTS, INC.
2048 FULTON ROAD, CLEVELAND 13, OHIO

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London

Speed Nuts *

PATENTED *Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

chandise of this type is folded, wrapped in tissue paper and stored in cases out of the reach of the customers. By arranging sample articles in these show cases, the goal of saving the merchandise from inquisitive hands would be achieved, yet the customer would be given a bird's-eye view of the line in a quarter of the time consumed today. This, of course, is in keeping with the trend toward greater accessibility of merchandise at the selling point.

Plastics may play a further role in displays of this type. In all its work, Ross-Frankel, Inc., is bending every effort to bring up the character of the merchandise. To do this the company is constantly experimenting with new lighting mediums—a field where plastics can be expected to take on increasingly important duties. Taking Fig. 3 as an example, the lighting for the end displays should bring out the texture of the bags and their color. The effect should be attractive and eye catching, but not of the spotlight type. Further, if the light source is in the overhang, it should not be arranged so that it blinds the eyes.

Hand in hand with these other improvements goes increased ease of movement on the part of the sales personnel. No more squeezing and straining to get past another sales girl. While space will not be wasted behind the counter, enough room will be left so that two can sell at the same department without being always in each other's way.

This article gives but an inkling of the use that can be made of plastics by the builders and designers of store displays and interiors. We will, without doubt, see the application of many more, and new, plastics to this type of work when the lifting of wartime restrictions on repairs and rebuilding permits stores throughout the country to undertake their long-planned renovation programs.

Credits—Designs by Ross-Frankel, Inc.

Washington round-up

(*Continued from page 178*) a large portion of thermosetting plastics is going into the war effort, there is **not** much likelihood that they will cut into the raw materials in a way that will seriously hamper production of war goods. It is almost inevitable that some civilian goods will be curtailed due to the increasing need for benzol products in the ammunition program.

In so far as formaldehyde is concerned, there is not much to add to what has already been told. It will probably continue on about the present basis with very little available for low-essential civilian items, but sufficient quantities to fill all war orders and enough to prevent plant shutdowns by the suppliers who use it for phenolic, urea and melamine resins. Methanol, from which formaldehyde is produced, will continue scarce, and there is always the chance that methanol hypers will be converted back to ammonia for the ammunition and fertilizer programs. However, at the present moment, that outcome seems remote. It is also possible that in the not too distant future, less ammonia will be available for urea crystal.

The acetate situation is different from prevailing conditions in thermosetting plastics because a larger portion of the available cellulose acetate production is used for civilian goods. Butyrate, on the other hand, is used largely for war purposes. In the shuffling that goes on when the country is on a war economy, there is always the chance that manufacture of less utilitarian materials will be partially or totally suspended until the eventual cessation of hostilities.

There is apparently no danger of cellulose acetate for civilian items being entirely wiped out, but increasing quantities will go for war purposes and production will decline at least 10 percent from the 5,500,000 lb. per month which had been normal until late 1944. Some authorities assert that flake from which cellulose acetate plastics are derived may become short some time next summer if there is no alleviation of war demands in general because of a possible lack of cotton linters and of wood pulp which are needed for the making of ammunition.

There are also rumors of a new war use for rayon that may possibly take flake away from plastics. But the greatest threats at the moment are plasticizers and acetic anhydride. The plasticizer shortage due to their use in ammunition, insecticides and other war items is still serious without much hope for alleviation despite substitutes and increased facilities in the offing. Acetic anhydride is used in great quantities in the manufacture of a potent explosive and there is little hope that it will become plentiful for plastics despite proposed new manufacturing facilities due for completion soon.

M-52 fuze program expanded

The plastics industry was concerned over WPB Chairman Krug's statement that the mortar ammunition program has been increased by $500,000,000. It has been learned that General Electric Co. has obtained the contract for more than two million per month additional M-52 thermosetting mortar shell fuzes which represent the increase in the plastics part of the program. Additional fuzes will also be manufactured from aluminum—mainly because of its availability and greater adaptability to one particular type of mortar shell. General Electric Co. has acquired an old textile plant in New England and is now busy converting it into a building for the exclusive manufacture of mortar shell fuzes.

Overseas post exchange items

According to a December 13 amendment to Priorities Regulation 17, goods directly on order from post exchanges and ships' stores overseas may have a military rating. All such goods have been treated as civilian orders in the past. The order is not very clear on the point of how overseas and domestic orders for post exchange goods are to be distinguished from each other, but it is probable that suppliers will not classify a post exchange order from one of their molders as military unless it has a definite overseas purchase order number.

Vinyl acetate revoked from allocation

Because the present supply of vinyl acetate is now in excess of requirements, WPB revoked Order M-240 on Dec. 14. Vinyl acetate was placed under allocation in October 1942 when the supply was inadequate to meet military and essential civilian needs.

Urea and melamine small order cut

Because of heavy military requirements for glycol ethers and urea and melamine aldehyde resins, the WPB on Jan. 6 amended Schedule 36 and Schedule 34 of Order M-300, the general chemicals allocation order, reducing the small order exemptions for these chemicals.

The monthly small order exemption for monobutyl ether of ethylene glycol was reduced from 4000 to 400 lb., according to the provisions of this amendment. Monobutyl ether of ethylene glycol is used in the production of chemicals as a solvent, in hydraulic fluids, for metal cleaners and metal cutting oils. Because of the critical supply of formaldehyde, used in the production of urea and melamine resins, the small order exemption was reduced from 2000 to 550 lb. a month.

Plastic laminates

(*Continued from page 137*) in the design, more bushings may be added at any time. Hard metal bushings, on the other hand, are built into the laminate at the time of fabrication. All surfaces of the metal are coated with lacquer to prevent the acid catalyst from etching or eating into them.

In the aircraft industry plastic laminated tooling is generally used in the assembly of aluminum or dural metal parts. These materials are generally used in the construction of fuselages, doors and bomb bays, cowlings, wings, tails, rudders and flaps. As parts of this type form the skin or surface sections of a plane they are characteristically large in area and of varying shapes and contours. Many such parts are first preformed by drop hammers or stretch presses. Being thin and light, they are easily sprung or distorted during subsequent drilling, routing and assembly operations.

Plastic laminates are easily and quickly fabricated into the identical shapes, contours and sizes of these parts. Thus, the laminate constitutes an accurate, rigid, form-fitting base over which the part is secured and held in the proper relation to other parts while in the process of assembly. Another primary tooling function of plastic laminates is to locate the drill holes and also to serve as guides for the drilling and router operations.

Such qualities as high impact strength, dimensional stability, and high compressive and tensile strength in relation to weight have boosted plastic laminates to an important position in the field of aircraft tooling.

Credits—Material: Cast resin, Nobell Resin Co. Tooling, Douglas Aircraft Co., Inc.

Extending the line

(*Continued from page 119*) sufficient supply of grease can be applied direct to working parts to insure proper lubrication of bearings and gears throughout the interval between periodic teardown for cleaning and inspection of parts for wear, which may be anywhere from one to four months, depending on the type of duty to which the drill is subjected.

2—*Plastic parts for the new portable drill are:* (A) *field case and side handle,* (B) *gear-case cover,* (C) *field-case cover,* (D) *trigger-type switch,* (E) *handle cover*

2

A wide variety of accessories may be used with the drill, including hole spotter, chuck protection sleeve, taper socket, sander attachment, mounted abrasive wheels, wire wheel brushes, polishing and sanding disks, and hole saws.

Early indications point to widespread acceptance of the new side-handle model in aviation production where its balance is said to be particularly suitable to high-speed work, which consists largely of punching holes instead of more sustained drilling.

Material: Variation of Tenite II. Molded by Anfinsen Molding Corp. for Independent Pneumatic Tool Co.

An eye to the future

(*Continued from page 116*) designs for the new postwar 'Dial-Ese' bathroom and kitchen faucets I have worked on for Crane Co. A few of those can be shown with safety because they are not the final designs, but merely stages in their creation.

"This new postwar line uses a plastic dial-type handle on the faucet instead of the conventional prewar handle. The name was not chosen because of the new plastic handle, however; it was selected because of a new principle in the faucet that enables one to turn water on and off with the same ease as one turns on a radio or a telephone. This new type of faucet is equally adaptable for use on the kitchen sink, the bathroom lavatory, the bathtub, or shower. And in this particular example, the beauty and workability of plastics lend themselves nicely to a simple, graceful, inconspicuous and very desirable handle.

"Of course, plastics may have many more uses in plumbing fixtures. The nozzles of dishsprays may be plastic. Or mixing-spout faucet and drain combinations may be mounted on a non-staining easy-to-clean plastic panel. But the whole point is that plastics probably won't be used in all the ways, or to the extent, that the public has been led to believe."

In other words, while the age of plastics is here, its future depends on how carefully the properties of these materials are kept in mind from the design stage of a particular product through to the article's actual production in plastics. Today there are still definite limits to what these materials can do, and neither consumers nor manufacturers should consider any plastic as 100 percent perfect.

Credits—Designs by Henry Dreyfuss for Crane Co.

Books and booklets

(*Continued from page 166*)

★ AN ENGINEERING MANUAL HAS BEEN PREPARED by Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis., to provide authoritative engineering, processing specifications and standards data on Consoweld high strength plastic materials in their many forms: impregnated materials—rolls, sheets and mats—large size standard moldings and large size custom moldings. The chapters, indexed alphabetically from A to J, include general facts, codes and specifications, materials, properties, standards, weight data, structural data, fabrication and processing, test methods, ordering, terminology and references.

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MODERN PLASTICS

AND PLASTICS

All editorial contents bearing on military subjects have been released for publication by the Armed Services.

MODERN PLASTICS is regularly indexed in the Industrial Arts Index.

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VOLUME 22 MARCH, 1945 NUMBER 7

General Section

Plastics—Engineering Section

Technical Section

News and Features

Plastic laminates

(*Continued from page 137*) in the design, more bushings may be added at any time. Hard metal bushings, on the other hand, are built into the laminate at the time of fabrication. All surfaces of the metal are coated with lacquer to prevent the acid catalyst from etching or eating into them.

In the aircraft industry plastic laminated tooling is generally used in the assembly of aluminum or dural metal parts. These materials are generally used in the construction of fuselages, doors and bomb bays cowlings, wings, tails, rudders and flaps. As parts of this type form the skin or surface sections of a plane they are characteristically large in area and of varying shapes and contours. Many such parts are first preformed by drop hammers or stretch presses. Being thin and light, they are easily sprung or distorted during subsequent drilling, routing and assembly operations.

Plastic laminates are easily and quickly fabricated into the identical shapes, contours and sizes of these parts. Thus, the laminate constitutes an accurate, rigid, form-fitting base over which the part is secured and held in the proper relation to other parts while in the process of assembly. Another primary tooling function of plastic laminates is to locate the drill holes and also to serve as guides for the drilling and router operations.

Such qualities as high impact strength, dimensional stability, and high compressive and tensile strength in relation to weight have boosted plastic laminates to an important position in the field of aircraft tooling.

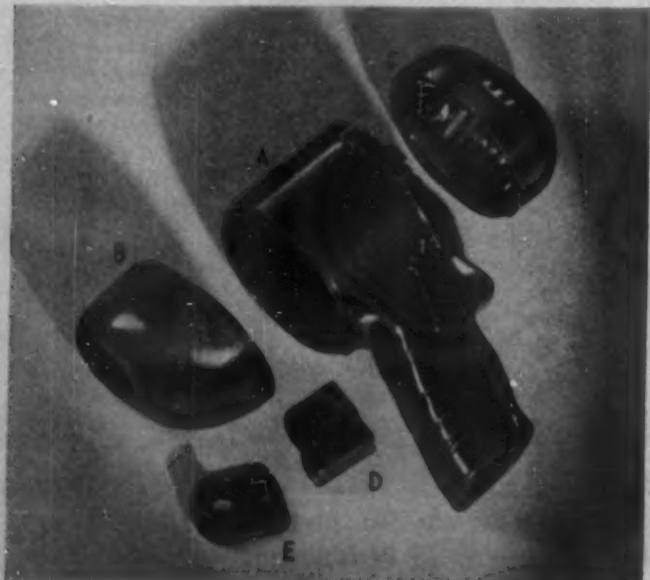
Credits—Material: Cast resin, Nobell Resin Co. Tooling, Douglas Aircraft Co., Inc.

Extending the line

(*Continued from page 119*) sufficient supply of grease can be applied direct to working parts to insure proper lubrication of bearings and gears throughout the interval between periodic teardown for cleaning and inspection of parts for wear, which may be anywhere from one to four months, depending on the type of duty to which the drill is subjected.

2—Plastic parts for the new portable drill are: (A) field case and side handle, (B) gear-case cover, (C) field-case cover, (D) trigger-type switch, (E) handle cover

2



A wide variety of accessories may be used with the drill including hole spotter, chuck protection sleeve, taper socket, sander attachment, mounted abrasive wheels, wire wheel brushes, polishing and sanding disks, and hole saws.

Early indications point to widespread acceptance of the new side-handle model in aviation production where its balance is said to be particularly suitable to high-speed work, which consists largely of punching holes instead of more sustained drilling.

Material: Variation of Tenite II. Molded by Anfinsen Molding Corp. for Independent Pneumatic Tool Co.

An eye to the future

(*Continued from page 116*) designs for the new postwar 'Dial-Ese' bathroom and kitchen faucets I have worked on for Crane Co. A few of those can be shown with safety because they are not the final designs, but merely stages in their creation.

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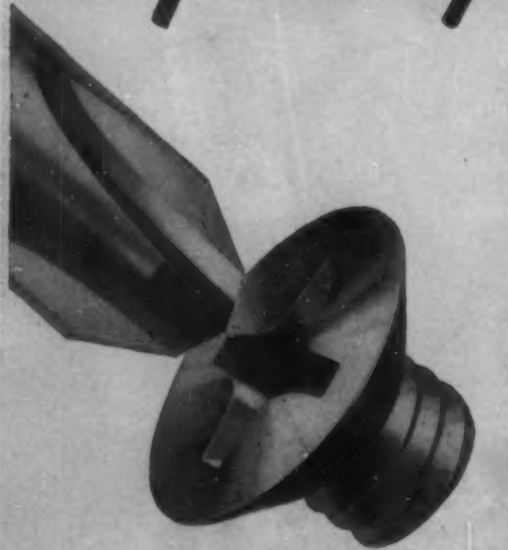

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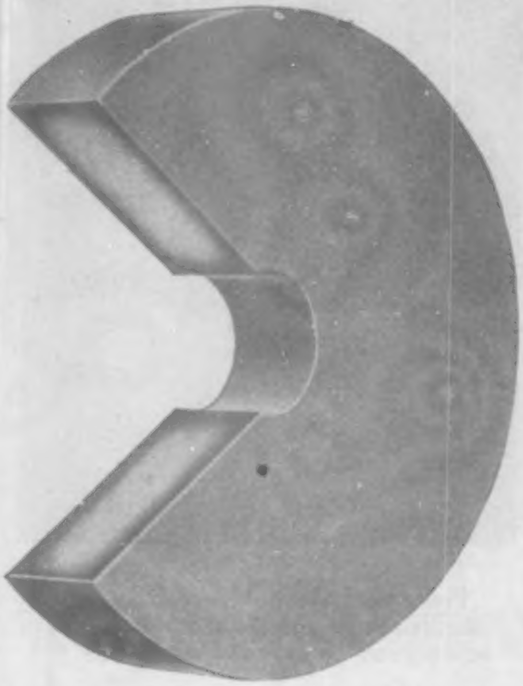
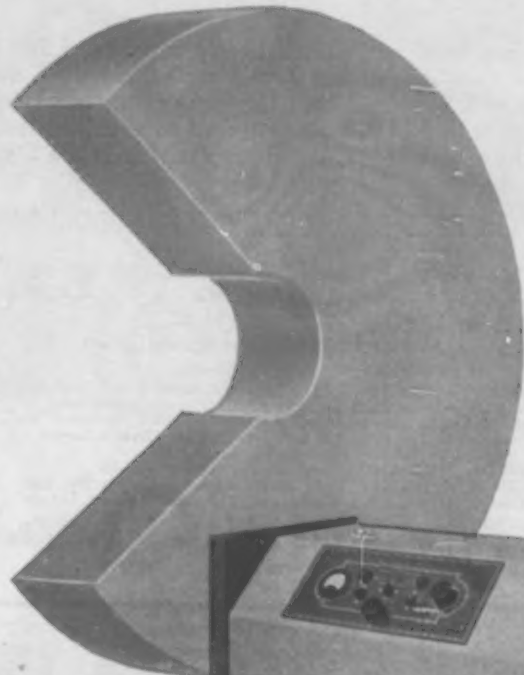


Cross section of grinding wheel . . . formerly oven baked . . . heat soaks in slowly from surface.



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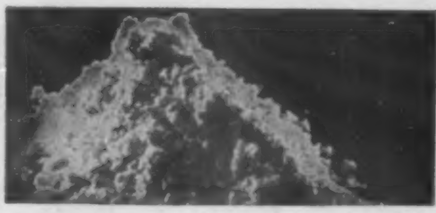
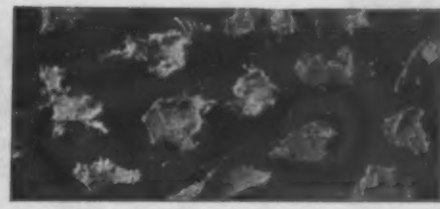


FILFLOC Pure cotton flock of surpassing cleanliness and uniformity.



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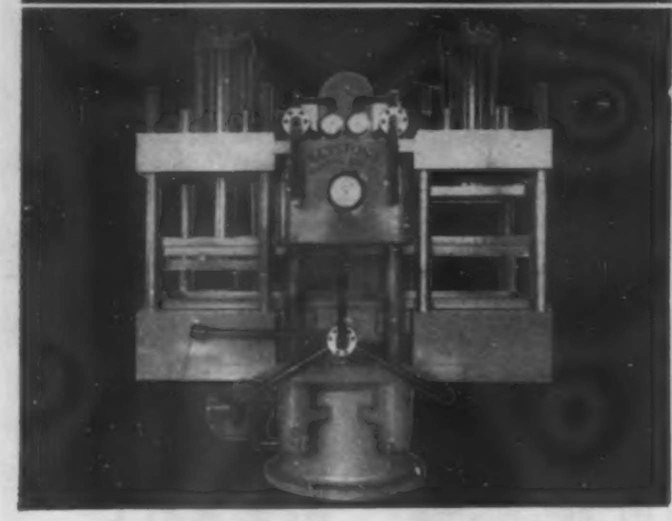

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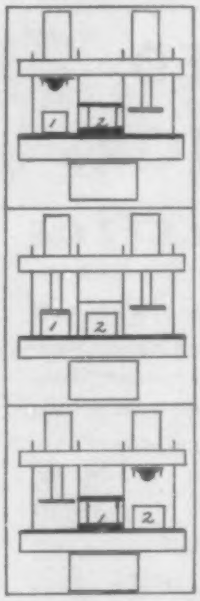

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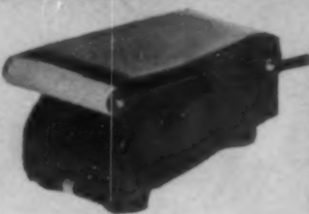

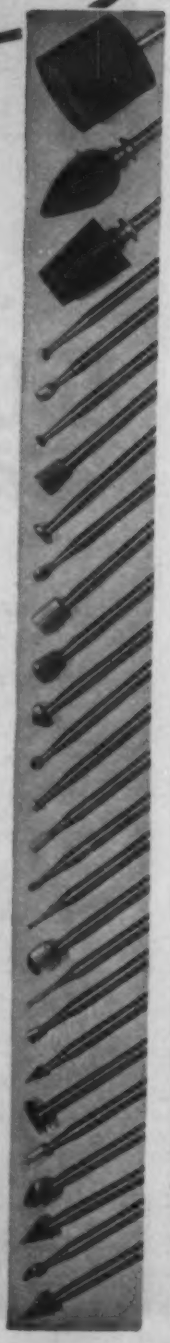

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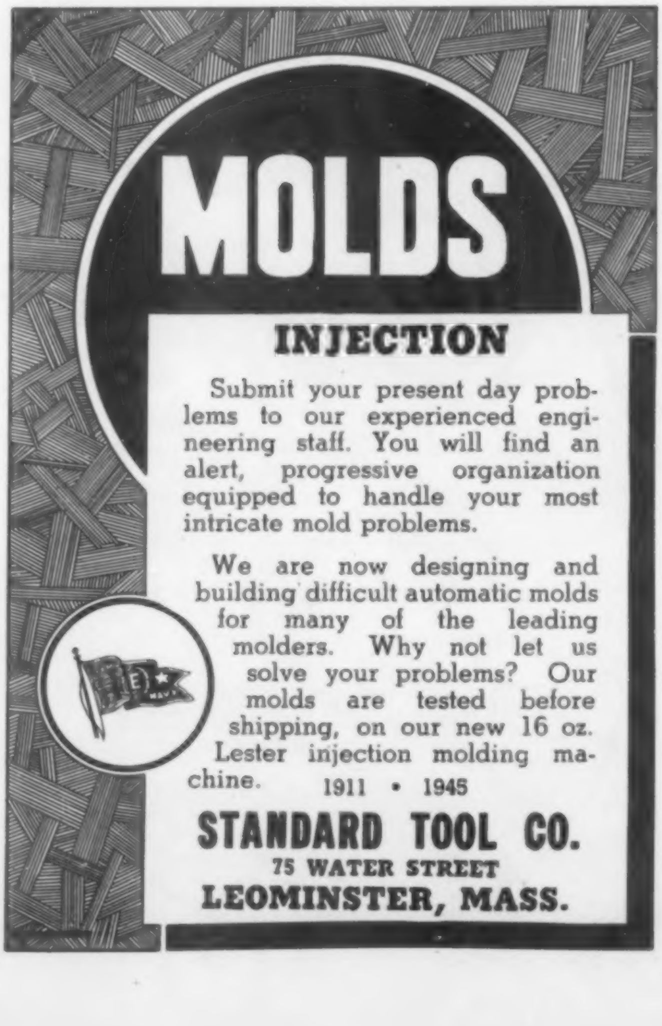

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PERMANENT CHEMIST WANTED for Research Laboratory investigations to improve and develop synthetic resin adhesives—essential war work at present. Salary in line with experience.

Plant within 200 miles of New York City. Attractive town and working conditions.

Applicant should have Ph.D. and organic chemical research experience, preferably in urea-, phenol- or resorcinol-resin adhesives.

Write, giving age, education, draft status, experience, salary expected and photo if available. Address R. J. Spahr, Casein Company of America, Bainbridge, N. Y.

WANTED—Close outs, job lots, discontinued items of any plastic items, other types of merchandise suitable for resale. Large or small quantities. Jane Company, 725 Rahway Ave., Elizabeth, N. J.

DRAFTSMEN—With experience wanted to train for Plastic Mold Designing. Vital War Work with excellent future. Write in detail to: Pro-Phy-Lac-Tic Brush Co., Personnel Mgr., Florence, Mass.

MANUFACTURERS REPRESENTATIVES WANTED

Midwest company, specializing in extruded plastic strip and sheeting, solid rods, tubes and other shapes, wishes to establish sales representatives in Chicago, Detroit, Cleveland, Cincinnati, St. Louis and other large centers throughout the United States. Splendid opportunity for substantial earnings on commission basis. Write in detail to Box 1180, Modern Plastics.

CANADIAN MARKET: Canadian Agency is interested in securing one or two non-conflicting manufacturers' lines, for immediate presentation or to lay ground work for post war marketing. Principally contacting Jewelry, Drug Sundry and Smallware trades, both retail and wholesale. Modern Plastics, Box 1181.

ATTENTION, MANUFACTURERS

Inventor would like to contact manufacturer to produce on royalty basis folding fountain comb; holds all makes of hair tonic; is practical and leakproof; has eye appeal; fits man's vest pocket or lady's purse. Can be made of plastic, aluminum or similar metal. A nation-wide market.
Write Grip-Rite Mfg. Co., 3171 North Palmer Street, Milwaukee 12, Wisconsin.

PLASTIC CHEMIST—Highly attractive position with excellent working conditions and unlimited future for a plastic chemist who is familiar with the manufacture of resins. Salary open. Write briefly stating age, experience and telephone number and a prompt interview will be granted. Reply Modern Plastics Box 1182.

WANTED METHYL METHACRYLATE SCRAP PIECES in any form. Prefer small cut-outs and ends. Submit samples and quote prices. Reply Box 1185, Modern Plastics.

FOR SALE: Vaughn Taylor Combination Calender and Mill unit on common base; mill rolls 6" x 12"; calender rolls 7½" x 14"; with 10 HP AC motor. First class condition. Box 1183, Modern Plastics.

WANTED
INDUSTRIAL PRODUCT DESIGNERS

Experienced in all phases of design—covering rendering, modeling, mechanical engineering fundamentals, and creative ability. Permanent position with excellent postwar possibilities.
Give complete details of personal qualifications, age, draft status, work history, present earnings, and salary expected in letter of application. Employment in line with W.M.C. regulations.
ADDRESS REPLY TO ENGINEERING DEPT., BEECH AIRCRAFT CORP., WICHITA, KANS.

MANUFACTURERS: Your POST WAR PLANS should include EXPORTING of part of your production. We desire finished products of PLASTICS AND SYNTHETICS either as export agents or as jobbers. Reply Box 1184, Modern Plastics.

FOR SALE: Combination Laboratory Mill and Calender Unit, M.D., Hydraulic Presses, 600 ton Watson Stillman 24" x 24", 1—36" x 36" 12" ram all steel constructed 200 tons, 4—2 post 18" x 20" 8" rams, 52" x 26" 14" ram, 2—12" x 12" 7½" rams, 2—12" x 12" 8" rams, 20" x 20" 14" ram, 2—32" x 50", 1 with 15" ram 4 openings, 1 with 6" ram 3 openings, 26" x 45" 10" ram, 1—38" dia. 12" ram, pump attached, 2—20" x 20" 15" rams, 1—15" x 15" 8" ram 4 openings. Pumps: Robertson Triplex 5 GPM 5000 lbs., Watson Stillman duplex high and low pressure, ¾ GPM 4000 lbs. continuous motor bedplate, Hele Shaw JLP 44 GPM 1200 lbs., HPM triplex 1¾ GPM 2000 lbs. on high 16 GPM 400 lbs. on low, V Belt drive, National triplex 1" x 3" 4000 lbs., Extruder; No. 2 Royle Perfected, Accumulator; weighted type 5" dia. 6' stroke; Mills, Calenders, Mixers, etc. Advise your requirements. HIGHEST PRICES PAID FOR YOUR USED EQUIPMENT. Universal Hydraulic Machinery Company, 285 Hudson Street, New York City 13.

WANTED: Engineer to supervise inspection and handle technical sales problems for Eastern molding firm. Plant experience in injection molding and familiarity with die design desirable. Reply Box 1186, Modern Plastics.

PRODUCT DESIGNER

Large Plastics Manufacturer specializing in extrusion and injection moulding seeks top notch designer with proven record for developing new products. Alert personality; approximately 35–40 with good knowledge of engineering fundamentals preferred. Location New York City. Equitable salary. Write in detail to Box 1187, Modern Plastics.

EXTRUSION MACHINE TIME AVAILABLE—If you have materials, we have the facilities to take care of your requirements. Address: Box 1188, Modern Plastics.

FOR SALE: Watson-Stillman 225 ton Transfer Molding Press; 12—Molding Presses 50 to 150 tons; also pumps and accumulators. STEIN EQUIPMENT CO., 426 BROOME ST., NEW YORK 13, N. Y. CANAL 6-8147.

PLASTICS ENGINEER. Thorough experience in management of custom compression molding plant. Capable of designing both finished part and molds. Fair knowledge of injection molding. Desires responsible position either in management or sales capacity with forward looking, well financed concern. Reply to Box 1189, Modern Plastics.

GREAT BRITAIN—Technical Director of large British Paint and Chemical Manufacturer producing all types of Paint, Varnish, Synthetic Resins and Synthetic Drying Oils, and raw materials for the Plastics industry, is now in the U. S. A. and would be happy to receive proposals from U. S. Manufacturers wishing to negotiate licenses for developing new products in British Empire. Please address all replies in triplicate to Box 1190, Modern Plastics.

WANTED—Injection Molding Machine and Equipment or smaller plant making injection molded Plastics. Box 1191, Modern Plastics.

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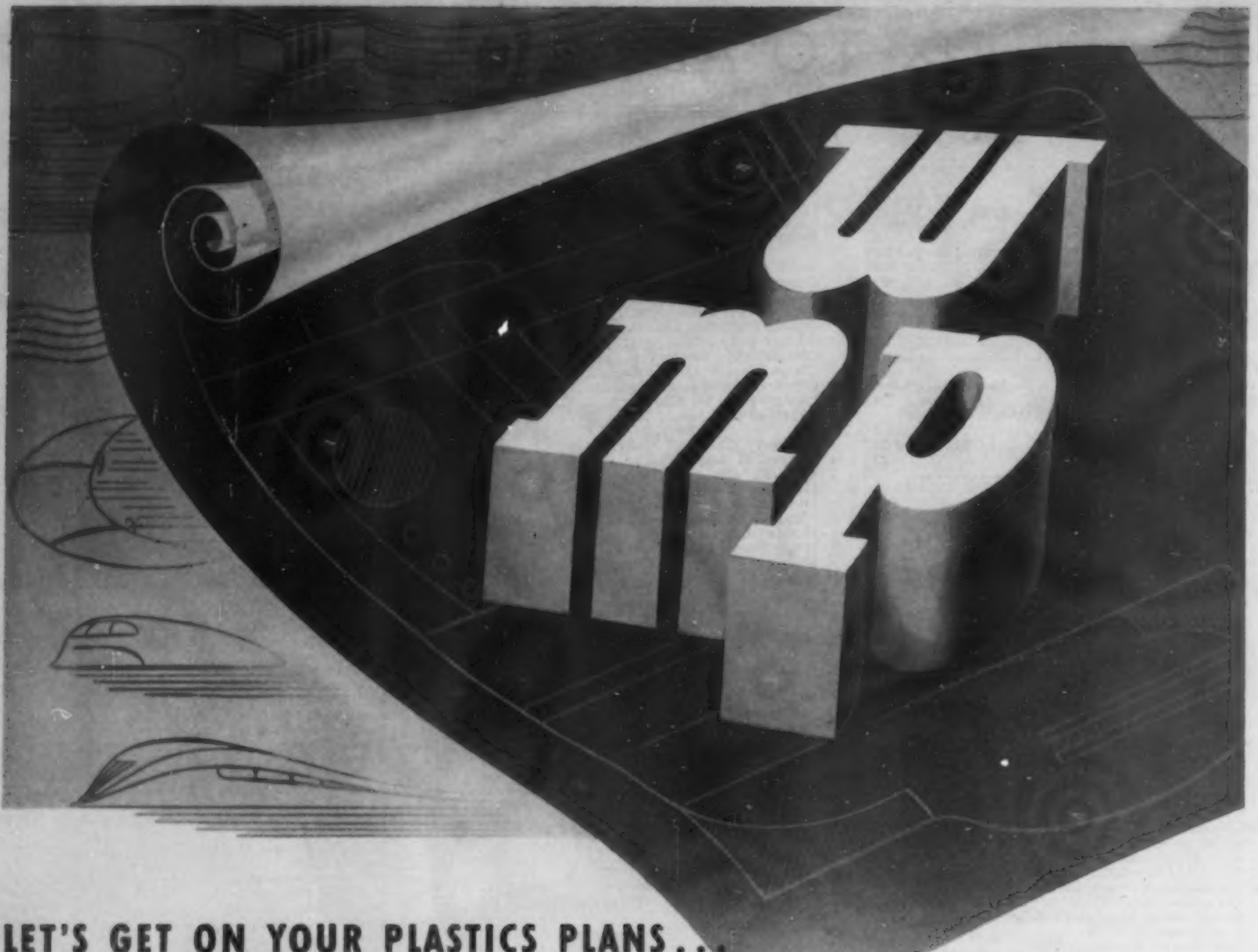
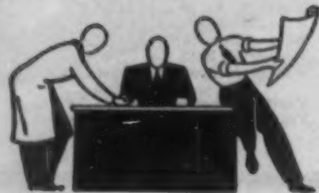


LET'S GET ON YOUR PLASTICS PLANS...

Even though the war decks remain far from cleared, future plastics applications in your field of manufacture are naturally under discussion. With increasing regularity such planning meetings take place with the Trio in attendance. The best way to tell how great a role may be assigned to plastics applications is to start from the beginning. Your plans may depend upon some form of plastics other than injection moulding. We tell you so. Or injection moulding may be the answer which at first glance never occurred to you, in which case you can count heavily on our unbiased experience as custom moulders, our moulding techniques and our unusual facilities. Let your thoughts of plastics take shape with the help of the Trio.



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